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UPPER STILLWATER BIG GAME TECHNICAL REPORT

Period of Study: December 1980-July 1982

Sponsored by:

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
DESCRIPTION OF STUDY AREA	2
PROCEDURES	3
Mule Deer	3
White-tailed Deer	3
Elk and Moose	4
Bighorn Sheep	4
General	4
RESULTS AND DISCUSSION	5
Mule Deer	5
Movements and Distribution	5
Population Characteristics	24
Potential Impacts	34
White-tailed Deer	36
History	36
Movements and Distribution	36
Population Characteristics	39
Potential Impacts	45
Elk	47
History	47
Movements	47
Distribution	55
Population Characteristics	58
Potential Impacts	60
Moose	61
Discussion	61
Bighorn Sheep	63
History	63
Population Dynamics	63
Distribution and Movements	72
Habitat Use	84
Hunting	86
Discussion and Summary	86
Potential Impacts	89
Black Bear	90
Population Density	90
Potential Impacts	92
APPENDIX	93

LIST OF TABLES

Page

1. Drive-net locations, numbers of mule deer marked and neckband color combinations used at each site, Upper Stillwater study area 6

2. Year-long home range sizes for radio-collared mule deer, Upper Stillwater study area, January 1, 1981-July 30, 1982 13

3. Capture dates and winter home range sizes for radio-collared mule deer, 1981 15

4. Spring 1981 home range sizes for radio-collared mule deer 17

5. Summer 1981 home range sizes for radio-collared mule deer 18

6. Fall 1981 home range sizes for radio-collared mule deer 19

7. Winter-spring home range sizes for radio-collared mule deer, Upper Stillwater study area (December 1, 1981-June 15, 1982) 20

8. Winter-spring home range statistics for neckbanded mule deer, Upper Stillwater study area (December 1, 1981-June 15, 1982) 21

9. Winter (March 1981) mule deer classifications, Upper Stillwater study area 24

10. Fall 1981 mule deer classifications by herd unit, Upper Stillwater study area (September 15, 1981-November 30, 1981) 25

11. Winter 1981-82 mule deer classifications by herd unit, Upper Stillwater study area (December 1, 1981-March 31, 1982) 26

12. Spring 1982 mule deer classifications by herd unit, Upper Stillwater study area (April 1, 1982-April 21, 1982) 26

13. Sex and age classes of captured mule deer, Upper Stillwater study area, March 1981 28

14. Sex and age classes of Upper Stillwarer mule deer, October 1981-April 1982[1] 30

15. Upper Stillwater mule deer population estimates and densities by helicopter survey unit, mid-March 1981 31

16. Upper Stillwater mule deer population estimates and densities by helicopter survey unit, mid-March 1982 32

17. The 1980 deer harvest statistics for hunting districts 520 and 572, as determined by the hunter questionnaire survey[1] 34

18. Capture locations and collar descriptions for radio-collared white-tailed deer, Upper Stillwater study area, February 1982 37

19. Home range size for radio-collared white-tailed deer marked on the Upper Stillwater study area, winter and spring 1982 38

20. Fall (September-November) white-tailed deer classification, Upper Stillwater study area, 1981 42

LIST OF TABLES (cont.)

Page

21. Winter white-tailed deer classification, Upper Stillwater study area, 1981-82 42

22. Sex and age classes of captured white-tailed deer, Upper Stillwater study area, February 1982 43

23. Upper Stillwater white-tailed deer population estimates and densities 1982 45

24. The 1980 deer harvest statistics for hunting districts 520 and 572, as determined by the hunter questionnaire survey[1] 45

25. Capture locations and collar descriptions for radio-collared elk, Upper Stillwater study area, 1981 48

26. Home range sizes for radio-collared elk marked on the Upper Stillwater study area, 1981-82 50

27. Percentage distribution of elk observations[1] on elk winter range units[2] 56

28. Total counts and classification of elk on the Upper Stillwater winter range, 1971-81 59

29. Size of the Stillwater bighorn population, post-hunting season, 1971-72 to 1981-82 65

30. Potential lamb production based on a birth rate of 90 lambs/100 ewes 3 years old and older and survival of lambs for the Stillwater bighorn population, 1971-72 through 1981-82 66

31. Number of yearlings, 2 and 3-year-old and older ewes in the Stillwater population during winter, 1971-72 to 1981-82 67

32. Average annual natural mortality of Stillwater ewes by age class, 1971-72 to 1981-82 68

33. Post-hunting season age distribution to Stillwater ram population, 1971-72 to 1981-82 69

34. Average annual natural mortality of Stillwater rams by age class, 1971-72 to 1981-82 70

35. Winter (December 1, 1980-April 21, 1981 and December 1, 1981-April 15, 1982) home range sizes and centers of activity for marked bighorn ewes on the Stillwater winter range 77

36. Winter (December 1, 1980-April 21, 1981 and December 1, 1981-April 15, 1982) home range sizes and centers of activity for marked bighorn rams on the Stillwater winter range 80

37. Home range sizes for four Stillwater bighorn ewes during winter 1976-77 through 1981-82 81

38. Spring (April 22-June 2) home range sizes and centers of activity for marked bighorn sheep from the Stillwater winter range, 1981 83

LIST OF TABLES (cont.)

Page

39. Summer (June 3-September 15) home range sizes and centers of activity for marked bighorn sheep from the Stillwater winter range, 1981 . . . 84

40. Comparative habitat use by Stillwater bighorn sheep during winters, 1974-75 and 1980-81 85

41. Hunting district 500 bighorn sheep harvest and hunter statistics, 1975-80 87

42. Spring 1981 black bear observations in vicinity of Minneapolis adit . 91

43. Capture locations and collar descriptions for radio-collared mule deer, Upper Stillwater study area, 1981-82 94

44. Marked bighorns on the Stillwater winter range during winter, 1980-81 96

LIST OF FIGURES

Page

1. Major mule deer winter range units, Upper Stillwater study area 1) = Beartooth, 2) = Keogh, 3) Stillwater, 4) = Limestone 7

2. Winter-early spring distribution of marked mule deer trapped on the Beartooth winter range unit, Upper Stillwater study area, 1981 and 1982 8

3. Winter-early spring distribution of marked mule deer trapped on the Keogh winter range unit, Upper Stillwater study area, 1981 and 1982 . . 9

4. Winter-early spring distribution of marked mule deer trapped on the Limestone winter range unit (Robinson Draw Site), Upper Stillwater study area, March-June 1982 10

5. Winter-early spring distribution of marked mule deer trapped on the Stillwater winter range unit (Magpie, Kirch and Dean sites), Upper Stillwater study area, 1981 and 1982 11

6. Year-long herd ranges for radio-marked mule deer associated with each major winter range unit, Upper Stillwater study area, 1981-82 12

7. Mule deer aerial survey units, Upper Stillwater study area (hatched areas were added to survey units #5 and #8 in 1982) 29

8. Winter-spring distribution of radio-marked white-tailed deer, Stillwater study area, February-July 1982 40

9. Winter-spring herd range for marked Upper Stillwater whitetails, February-July 1982 41

10. White-tailed deer aerial survey area, Upper Stillwater study area, 1982 44

11. Major white-tailed deer road-crossing areas, Upper Stillwater study area (+'s denote sightings of marked whitetails only) 46

12. Major elk winter range units, Upper Stillwater study area (1 = Main Stillwater, 2 = Horseman Flats, 3 = Picket Pin, 4 = Lodgepole) 49

13. Year-long herd range for radio-marked elk, Upper Stillwater study area, 1981-82 51

14. Seasonal herd ranges for radio-marked elk, Upper Stillwater study area, 1981 52

15. Winter and spring 1982 herd ranges for radio-collared elk, Upper Stillwater study area 53

16. Year-long range of radio-marked cow moose, Upper Stillwater study area, 1981 62

17. Bighorn sheep winter range, Upper Stillwater study area 73

18. Year-long distribution of marked rams and ewes, Upper Stillwater study area, 1980-82 76

LIST OF FIGURES (cont.)

Page

19. Winter 1980-81 relocations of marked bighorn sheep, Upper Stillwater study area 78

20. Winter 1981-82 relocations of marked bighorn sheep, Upper Stillwater study area 79

INTRODUCTION

Recent increases in mineral exploration, accompanied by proposals for major hardrock mining operations in the Stillwater Mineral Complex, have prompted the need for information regarding effects of these activities on the wildlife resource. This study was initiated in mid-December 1980 and continued through June 1982 to determine potential impacts of a proposed mining development on big game species in the Upper Stillwater Valley. The study was sponsored by the Anaconda Minerals Company, which has proposed development of a platinum and palladium mine and milling operation in the vicinity of Nye. Field research was conducted by personnel of the Montana Department of Fish, Wildlife and Parks (MDFWP).

Unique edaphic and climatic characteristics of the Upper Stillwater Valley make it an important wintering area for several big game species. Detrimental impacts to critical winter ranges could have potentially devastating effects on populations over an extensive geographic area in the case of migrant big game populations. Hence, the particular need to determine potential impacts to wintering big game populations in the vicinity of the proposed mine and mill operations.

The purpose of this study is to assess the nature and extent of potential impacts and to seek means of minimizing or eliminating negative impacts of the proposed development on big game populations. Species studied were mule deer, white-tailed deer, elk, moose and bighorn sheep. Study objectives included investigation of the following for each population:

1. Movements: Normal travel patterns, seasonal shifts, shifts associated with specific biological demands (i.e., breeding, birth) and shifts associated with human activity.

2. Distribution: "Normal" distribution patterns and factors influencing distribution such as biological needs and human disturbances.

3. Population Characteristics: Including sex and age structure, population densities and turnover rates.

Data obtained for black bears, incidental to research on other species, is also presented. Results of this investigation will be used by the Montana Department of State Lands and the U. S. Forest Service in preparing an environmental impact statement (EIS) for the Anaconda Minerals Company.

Previous work on big game wildlife of this area was conducted by Knapp (1973), Stewart (1975) and Stoneberg (1977).

DESCRIPTION OF STUDY AREA

The study area is located in Stillwater County approximately 35 miles south of Big Timber, Montana in the vicinity of Nye. Boundaries of the winter study area are the Fishtail Road on the south (from Fishtail to Nye) and the Stillwater Road on the north (from Nye to the junction with Bridger Creek Road), including the area approximately 5 miles north and 5 miles south of the road between Nye and the Woodbine Campground. The study area was expanded in the spring to include migration of big game animals to summering areas.

Topography of the Upper Stillwater Drainage is typified by rugged mountainous terrain with an associated foothill zone. Vegetation ranges from thick coniferous cover and alpine zones in mountainous areas to scattered timber, deciduous river bottom and "prairielike" habitats in foothill areas. Climate of the area is best described as mountainous continental, characterized by wide diurnal and annual temperature fluctuations. Average annual precipitation recorded at Red Lodge, 35 miles to the southeast, is 23.2 inches. Over 50% of total precipitation falls during the months March through June.

The winter of 1980-81 was exceptionally mild. Spring plant phenology was advanced, with spring "green-up" beginning the last week of March. The winter of 1981-82 was fairly mild during the months December through March. The most severe winter conditions occurred during the first half of April, a period punctuated by several substantial snowstorms. Snow compaction, resulting from alternate thawing and freezing temperatures, created conditions unfavorable for wildlife. Prolonged cool temperatures during the spring of 1982 delayed "green-up" until mid-May.

PROCEDURES

Mule Deer

Mule deer were captured utilizing a helicopter drive-net 800 feet long and 8 feet high (6-inch mesh) supported on poles in an A-frame configuration. Helicopter drives were conducted on January 11-13 and March 1-2, 1981 and March 16-17, 1982. All deer captured were sexed, aged (by tooth eruption and wear) and marked with metal ear tags in each ear. In addition, each deer was fitted with either an individually recognizable neckband or radio transmitter collar. Neckbands were made of 4-inch-wide Armortite material (inside diameter 19 inches for females and 25-28 inches for males) painted with Tuflex paint in a variety of patterns and symbols. Radio transmitter collars were constructed by inserting a premade AVM transmitter package into heated PVC pipe and molding it to an inside diameter of 19 inches for females and 25 inches for males. Radio collars were placed on adults only, and neckbands placed on fawns were stapled to prevent loss. One deer was captured using a Cap-Chur gun and liquid dart containing 3 cc's of xylazine (Rompun, 100 mg/ml concentration).

White-tailed Deer

A study of white-tailed deer in the Upper Stillwater Valley was initiated in September 1981. White-tailed deer were captured utilizing Clover (1954) traps. Trapping operations were initiated in early February and completed by early March 1982. All deer captured were sexed, aged (by tooth eruption and wear) and marked with metal eartags in each ear. In addition, each deer was fitted with either an individually recognizable neckband or radio transmitter collar. Neckbands were made of 4-inch-wide Armortite material (inside diameter 18-19 inches for females and 23-24 inches for males) painted with Tuflex paint in a variety of patterns and symbols. Five does received PVC radio collars; an additional doe and buck were fitted with radio collars constructed with conveyor belting. Radio collars were placed on adults only, and neckbands placed on fawns were stapled to prevent loss.

Elk and Moose

Elk and moose were darted from a helicopter on March 3-4 and April 14-16, 1981 using a Cap-Chur gun and liquid darts containing Anectine in doses of 20-24 mg for elk and 18-20 mg for moose. All animals captured were fitted with radio transmitter collars, and each ear was marked with an individually numbered plastic cattle tag. Four of the cow elk received PVC radio collars and the remaining cow and bull elk and cow moose were fitted with radio collars constructed with conveyer belting. Symbols on radio collars were designed to be individually recognizable by visual observation.

Bighorn Sheep

Bighorn sheep were darted from the ground or from a vehicle using a Cap-Chur gun and liquid darts containing 2-3 cc's of Rompun (100 mg/ml concentration). Ewes were fitted with PVC radio collars and rams were fitted with belting type radio collars. All sheep captured also received individually numbered yellow plastic cattle tags in each ear. Rams were aged by counting annual horn rings (Geist 1966). Ewes were aged by incisor replacement for ages 1 through 4 and by counting annual rings thereafter. Annual ring counts may underestimate the actual age of older ewes (Geist 1971); however, 70% of the ewes captured were 4 years old or less, and only 10% were over 6 years old. Thus, effects of this bias were negligible.

General

Ground observations were made from a vehicle with the aid of 7x35 binoculars and a 15-60X spotting scope. All radio relocations were made using an AVM 4-band, 12-channel receiver (Model LA12) and 4-element Yagi antenna. Aerial observations and radio relocations were made from a fixed wing aircraft (Piper Super Cub) equipped with antenna. Early winter helicopter surveys were conducted January 19-20, 1981 and spring surveys April 14-15, 1981 and April 22-23, 1982. These surveys were conducted during early morning and evening hours on the winter study area.

Date, total numbers, sex, age, antler class, location (UTM grid), habitat/cover type and marked animals were recorded for each observation. Times of the beginning and end of each observation period and general weather and snow conditions were also recorded.

For description of animal movement data, seasons were delineated as follows: winter (December 1 to April 15); spring (April 16 to June 15); summer (June 16 to September 15); fall (September 16 to November 30). Seasonal home range sizes were calculated using the minimum area method (Mohr 1947). Animal movement data were analyzed using a MDFWP computer program adapted to a Honeywell CP6 computer.

RESULTS AND DISCUSSION

Mule Deer

Capture efforts resulted in the marking of 143 mule deer in 1981. Of these, 15 were fitted with radio collars and 128 were marked with individually recognizable neckbands. A total of 85 mule deer were marked in 1982, 9 with radio collars and 76 with neckbands. Drive-net locations and neckband color combinations used at each site are listed in Table 1. A complete list of mule deer radio-collared on the Upper Stillwater study area, including collar descriptions, is presented in Appendix Table 43.

Movements and Distribution

Movements and distribution of marked deer indicate the existance of four major mule deer herd segments within the study area, each associated with a separate winter range unit (Fig. 1). Winter-early spring distribution (1981 and 1982) of mule deer marked in each winter range unit is presented in Fig. 2 through 5. Distribution of radio-marked deer during the study period made it possible to tentatively define year-long herd ranges for deer associated with each winter range unit (Fig. 6).

Year-long home range sizes for radio-collared mule deer are presented in Table 2. Extensive migratory movements for Beartooth does #309, #308 and #109 are indicative of the migratory nature of that herd segment. Year-long home

Table 1. Drive-net locations, numbers of mule deer marked and neckband color combinations used at each site, Upper Stillwater study area

Site Name	Drive-net Locations (UTM)	Number Marked		Neckband Color (Base/Symbols)
		1981	1982	
Beartooth	5863, 50245	4NB, 3RC[1]		Red/white
Keogh	5873, 50290; 5908, 50324	30NB, 4RC	23NB, 1RC	White/black Yellow/red
Hertzler Knob	5944, 50333	2RC		
Robinson Draw	5920, 50341		20NB, 5RC	Light blue/black
Magpie	5975, 50325	44NB, 2RC	18NB, 1RC	Green/white Red/yellow Black/white
Kirch	6004, 50310	15NB, 2RC		Yellow/black
Dean	6037, 50295; 6047, 50310	35NB, 2RC	15NB, 2RC	Dark blue/white Lt. blue/yellow (+2 Yellow/black)

[1]NB = neckband, RC = radio collar.

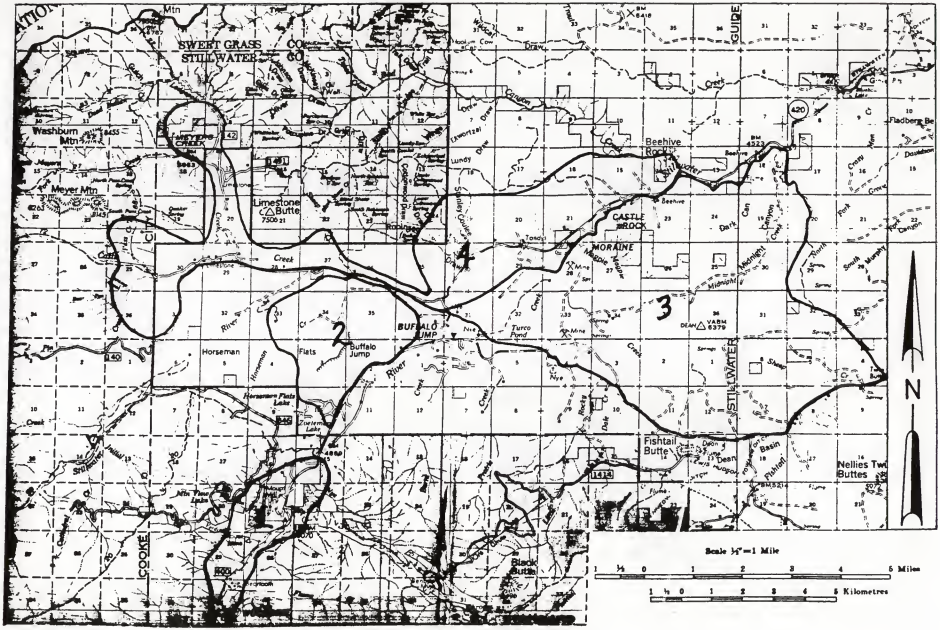

Fig. 1. Major mule deer winter range units, Upper Stillwater study (1 = Beartooth, 2 = Keogh, 3 = Stillwater, 4 = Limestone).

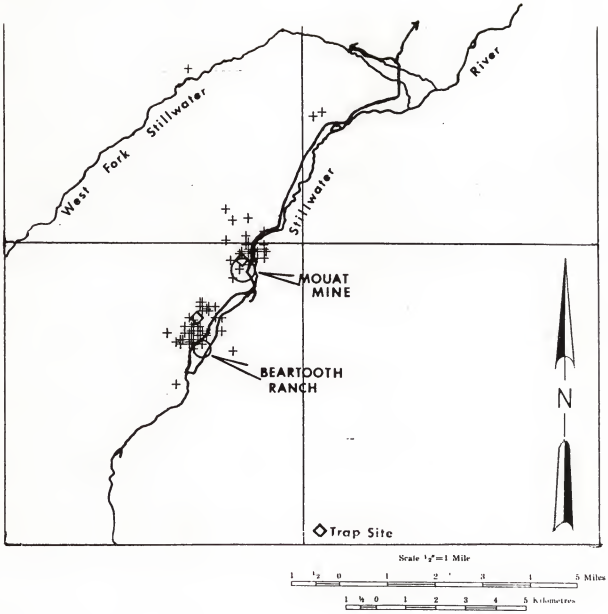

Fig. 2. Winter-early spring distribution of marked mule deer trapped on the Beartooth winter range unit, Upper Stillwater study area, 1981 and 1982.

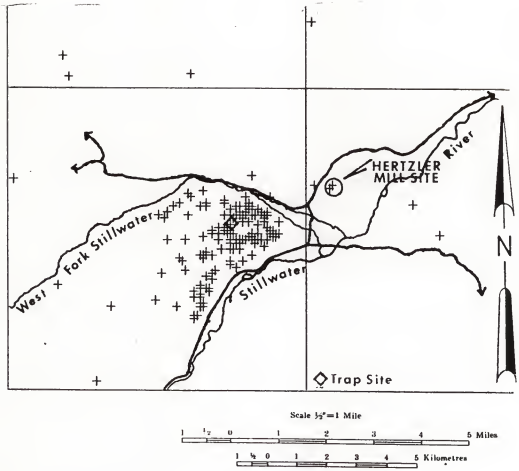

Fig. 3. Winter-early spring distribution of marked mule deer trapped on the Keogh winter range unit, Upper Stillwater study area, 1981 and 1982.

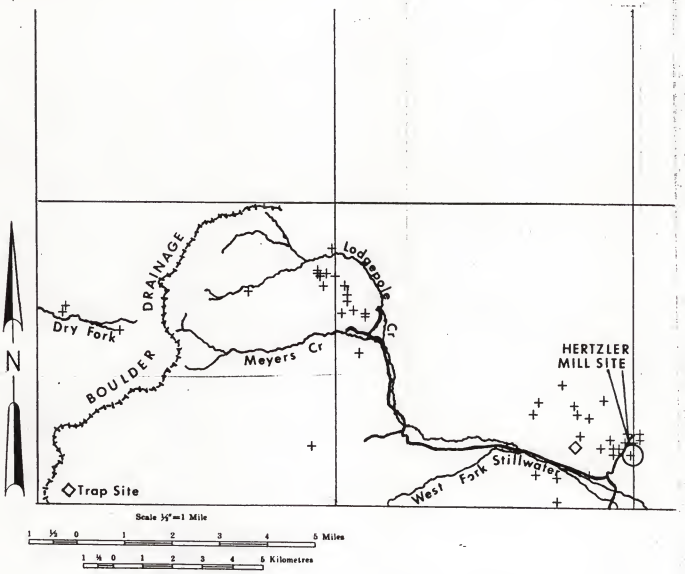

Fig. 4. Winter-early spring distribution of marked mule deer trapped on the Limestone winter range unit (Robinson Draw Site), Upper Stillwater study area, March-June 1982.

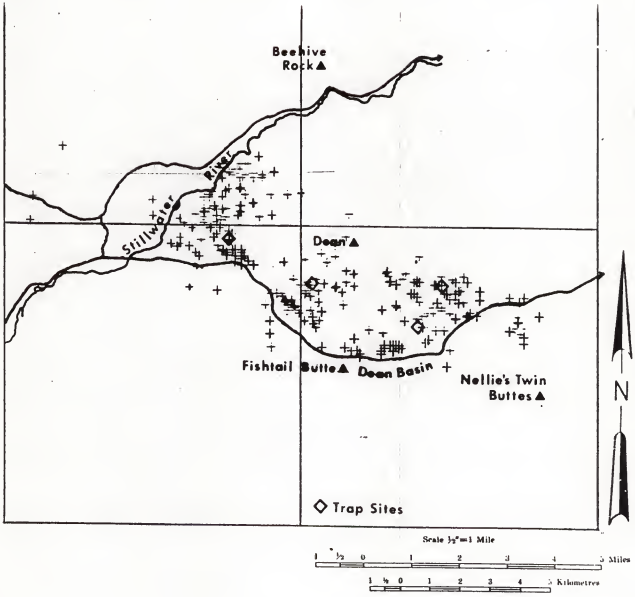

Fig. 5. Winter-early spring distribution of marked mule deer trapped on the Stillwater winter range unit (Magpie, Kirch and Dean sites), Upper Stillwater study area, 1981 and 1982.

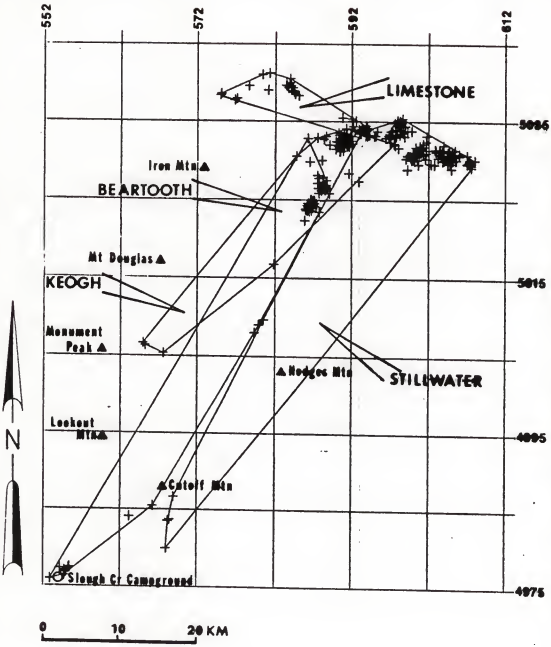

Fig. 6. Year-long herd ranges for radio-marked mule deer associated with each major winter range unit, Upper Stillwater study area, 1981-82.

range size for these does was between 216 and 294 km^2 (83 and 113 mi^2). To date, does captured on the Keogh and Stillwater units have exhibited small year-long movements and are considered resident deer. However, bucks marked in the Keogh and Stillwater units did exhibit migratory behavior (#101 and #305).

Information regarding year-long distribution of deer trapped at the Robinson Draw site (Limestone winter range unit) is incomplete as of this report date. However, as of June 30, 1982 two adult bucks from that herd segment had traveled to the Dry Fork of the East Boulder River, approximately 18 airline km (11 mi) northwest of where they were marked. It is strongly suspected that other deer marked at the Robinson Draw site migrate to the East Boulder vicinity as well.

Table 2. Year-long home range sizes for radio-collared mule deer, Upper Stillwater study area, January 1, 1981-July 30, 1982

Herd Unit[1]	Capture Site	Animal ID	Total Relocations	Polygon Home Range km^2	Polygon Home Range Mi^2
1	Beartooth	309 ♀	29	234.2	90.4
		308 ♀	34	294.2	113.6
		109 ♀	27	216.0	83.4
			Cumulative Area:	367.8	142.0
2	Keogh	212 ♀	29	2.5	1.0
		101 ♂	21	169.6	65.5
			Cumulative Area:	230.8	89.1
4	Magpie	209 ♀	23	6.0	2.3
		305 ♂*	17	247.0	95.3
		403 ♀	27	2.8	1.1
			Cumulative Area:	247.4	95.5
	Dean	211 ♀	25	6.7	2.6
		311 ♀	22	4.7	1.8
			Cumulative Area:	13.3	5.1
	Kirch	310 ♀	22	2.9	1.1
		312 ♀	25	9.3	3.6
			Cumulative Area:	9.3	3.6
	Cumulative range of all radio-marked deer			1,520.2	586.8

[1] 1 = Beartooth, 2 = Keogh, 4 = Stillwater.

*Transmitter failed in September 1981.

A summary of seasonal distribution and movement of marked mule deer follows:

Winter: Winter 1981 home range sizes for radio-marked mule deer are summarized in Table 3. Only three individuals had a seasonal home range larger than 2.6 km^2 (1 mi^2). Movements of neckbanded deer from time of capture (January and March) until the middle of April were limited also. The spring helicopter survey (April 14 and 15) indicated that the majority of marked deer were still in the general vicinity of their capture sites. Spring "green-up" prompted a movement of deer from higher elevations to south-facing slopes and lower elevation hayfields. Spring plant phenology was probably advanced due to mild weather. Use of new growth at lower elevations began the last week of March and continued through the last week of April when deer began to disperse. The Hertzler hayfields (the proposed mill site) received extensive use during spring "green-up." As many as 130 mule deer were observed in this vicinity during April.

Several winter-early spring mule deer concentration areas (winter range units) were delineated within the study areas as follows (Fig. 1):

1. Beartooth Unit - The Mouat mine site north to the Flying Mule Ranch, the reclamation east of the Stillwater River and the Stillwater Canyon between the Mouat mine and the Woodbine trailhead, including the Beartooth Ranch. This winter range is used by the Beartooth herd segment.

2. Keogh Unit - The eastern portion of Horseman Flats and Horseman Creek. This winter range is used by the Keogh herd segment.

3. Stillwater Unit - The area within the triangle bounded by Dean, Beehive and Nye. This winter range unit is used by deer of the Stillwater herd segment including individuals trapped on the Magpie, Dean and Kirch sites.

4. Limestone Unit - The area north of the Stillwater River and Bush Mountain to the Bad Canyon divide, between Beehive and Nye; a narrow corridor consisting of open slopes adjacent to the West Fork of the Stillwater River and

Table 3. Capture dates and winter home range sizes for radio-collared mule deer, 1981

Herd Unit[1]	Capture Site	Animal ID	Capture Date	Number Relocations	Polygon Home Range km^2	Polygon Home Range mi^2
1	Beartooth	309 ♀	1/11/81	12	1.88	.73
		308 ♀	1/13/81	12	4.04	1.56
		109 ♀	2/23/81	6	.49	.19
2	Keogh	210 ♀	1/11/81	8	1.67	.65
		212 ♀	1/11/81	6	.37	.14
		101 ♂	1/11/81	3	.04	.02
		102 ♂	1/11/81	5	.84	.33
3	Hertzler	307 ♂	1/13/81	8	.43	.17
4	Magpie	209 ♀	1/13/81	5	2.13	.82
		305 ♂	1/12/81	7	4.95	1.91
		403 ♀	1/11/81	7	.33	.13
	Dean	211 ♀	1/13/81	4	1.21	.47
		311 ♀	3/2/81	3	.62	.24
	Kirch	310 ♀	1/12/81	3	.10	.04
		312 ♀	1/12/81	7	4.11	1.59

[1] 1 = Beartooth, 2 = Keogh, 3 = Limestone, 4 = Stillwater.

Castle and Lodgepole creeks, including a portion of the Picket Pin Ranch and an area directly north of the Meyers Creek Ranger Station. This winter range unit is used by the Limestone herd segment, including individuals trapped on the Hertzler and Robinson Draw sites, and individuals marked in the Picket Pin and Meyers Creek vicinities as part of a big game study funded by Stillwater PGM.

Spring 1981: Spring 1981 movements of radio-collared mule deer are summarized in Table 4. Spring home ranges were less than 5.1 km^2 (2 mi^2) for all but the three radioed Beartooth unit deer. Does #309, #308 and #109 moved up the Stillwater River in mid-May, crossed the divide into Slough Creek and traveled down Slough Creek to the Slough Creek Campground area where they were located on a May 29 flight. The movement of all three of these does to the same summering area is indicative of the migratory tradition of the entire Beartooth herd segment.

Summer 1981: Summer 1981 movements of radio-collared deer were very limited with the exceptions of buck #305 (marked at the Magpie site) and buck #101 (marked at the Keogh site) (Table 5). Buck #305 moved up the Stillwater River to the mouth of Wounded Man Creek in June.- This deer was relocated on Elk Tongue Creek (southwest of Cutoff Mountain) in early July, on Cutoff Ridge at the end of July, then spent all of August in the vicinity of Cutoff Mountain. The summer home range of buck #305 encompassed 27.8 km^2 (10.7 mi^2).

Buck #101 remained in the Horseman Creek-West Fork Stillwater vicinity during June and early July, and was relocated at the head of Slough Creek at the end of July. This individual remained on the East Fork of the Boulder River, west of Lake Columbine, through the month of August. The summer home range of buck #101 encompassed 41 km^2 (16 mi^2).

Fall 1981: Fall 1981 home ranges for radio-marked mule deer are summarized in Table 6. Movement was limited and home range size was substantially less than 2.6 km^2 (1 mi^2) for all except Beartooth doe #109. The transmitter worn

Table 4. Spring 1981 home range sizes for radio collared mule deer

Herd Unit[1]	Capture Site	Animal ID	Number Relocations	Polygon Home Range km^2	Polygon Home Range mi^2
1	Beartooth	309 ♀	6	109.40	42.23
		308 ♀	6	152.25	58.77
		109 ♀	5	130.01	50.18
2	Keogh	210 ♀	4	4.64	1.79
		212 ♀	5	.46	.18
		101 ♂	3	1.43	.55
		102 ♂	3	.36	.14
3	Hertzler	307 ♂	5	1.19	.46
4	Magpie	209 ♀	4	3.47	1.34
		305 ♂	3	2.92	1.13
		403 ♀	3	Essentially no movement observed.	
	Dean	211 ♀	4	1.60	.62
		311 ♀	3	.26	.10
	Kirch	310 ♀	4	.45	.17
		312 ♀	3	.63	.24

[1] 1 = Beartooth, 2 = Keogh, 3 = Limestone, 4 = Stillwater.

Table 5. Summer 1981 home range sizes for radio-collared mule deer

Herd Unit[1]	Capture Site	Animal ID	Number Relocations	Polygon Home Range km^2	Polygon Home Range mi^2
1	Beartooth	309 ♀	3	Essentially no movement observed.	
		308 ♀	3	.02	.01
		109 ♀	3	.13	.05
2	Keogh	210 ♀	Transmitter failed		
		212 ♀	5	.18	.07
		101 ♂	4	41.14	15.88
		102 ♂	Died		
3	Hertzler	307 ♂	4	1.30	.50
4	Magpie	209 ♀	5	.28	.11
		305 ♂	5	27.82	10.74
		403 ♀	5	.26	.10
	Dean	211 ♀	5	1.55	.60
		311 ♀	5	.91	.35
	Kirch	310 ♀	5	.18	.07
		312 ♀	5	.05	.02

[1] 1 = Beartooth, 2 = Keogh, 3 = Limestone, 4 = Stillwater.

by buck #305 failed in September. Buck #101 was relocated just south of Lake Columbine in mid-October and in Flood Creek in early November.

Table 6. Fall 1981 home range sizes for radio-collared mule deer

Herd Unit[1]	Capture Site	Animal ID	Number Relocations	Polygone Home Ranges km^2	mi^2
1	Beartooth	309 ♀	3	1.12	.43
		308 ♀	3	1.12	.43
		109 ♀	3	4.22	1.63
2	Keogh	212 ♀	3	.33	.13
		101 ♂	Less than three for home range calculation		
3	Hertzler	307 ♂	Died		
4	Magpie	209 ♀	4	.05	.02
		305 ♂	Transmitter failed		
		403 ♀	3	.21	.08
	Dean	211 ♀	4	.15	.06
		311 ♀	3	.32	.12
	Kirch	310 ♀	3	.03	.01
		312 ♀	3	Essentially no movement observed	

[1] 1 = Beartooth, 2 = Keogh, 3 = Limestone, 4 = Stillwater.

Migratory mule deer exhibited individual variability in timing of return to wintering areas in the Upper Stillwater Valley in 1981. Buck #305 was observed in the Magpie vicinity by the end of October. The remaining migratory individuals returned during the latter half of December.

Winter-Spring 1981-82: The winter of 1981-82 was in the "normal" range of severity for the study area, in contrast to the exceptionally mild winter of 1980-81. Prolonged cool spring temperatures delayed "green-up" until mid-May. Large concentrations of mule deer at lower elevations were not observed during the 1982 spring to the extent that they have been observed in past years. Once new green forage was available, deer dispersal was expeditious, corresponding

to rapid elevational progression of "green-up."

It was difficult to monitor movements of radio-collared deer during the 1981-82 winter and 1982 spring, due to prevailing inclement flying conditions. Therefore, winter and spring relocations of marked individuals were combined for home range area calculations and are presented in Tables 7 and 8.

Table 7. Winter-spring home range sizes for radio-collared mule deer, Upper Stillwater study area (December 1, 1981-June 15, 1982)

Herd Unit	Capture Site	Animal ID	Capture Date	Number Relocations	Polygon Home Range km^2	Mi^2
1	Beartooth	309 ♀	1/81	6	4.59	1.77
		308 ♀	1/81	11	.52	.20
		109 ♀	2/81	8	1.97	.76
				Cumulative Area:	8.07	3.12
2	Keogh	210 ♀	1/81	3	.02	.01
		212 ♀	1/81	8	.57	.22
		101 ♂	1/81	8	.57	.22
		202 ♀	3/16/82	5	6.71	2.59
				Cumulative Area:	16.08	6.21
3	Robinson Draw	225 ♀	3/16/82	6	5.38	2.07
		206 ♂	3/16/82	6	6.34	2.45
		302 ♀	3/16/82	6	5.80	2.24
		304 ♀	3/16/82	4	9.59	3.70
		307 ♂	3/16/82	7	24.40	9.42
				Cumulative Area:	75.3	29.08
4	Magpie	209 ♀	1/81	4	Essentially no movement observed	
		403 ♀	1/81	7	2.44	.94
		404 ♀	3/17/82	6	1.78	.69
				Cumulative Area:	4.28	1.65
	Dean	211 ♀	1/81	6	1.32	.51
		311 ♀	3/81	7	1.06	.41
		204 ♀	3/17/82	6	.60	.23
		407 ♀	3/17/82	5	.55	.21
				Cumulative Area:	5.67	2.19
	Kirch	310 ♀	1/81	5	.32	.12
		312 ♀	1/81	5	.10	.04
				Cumulative Area:	.96	.37

[1] 1 = Beartooth, 2 = Keogh, 3 = Limestone, 4 = Stillwater.

$\frac{42.62}{21} = 2.0$

Table 8. Winter-spring home range statistics for neckbanded mule deer, Upper Stillwater study area (December 1, 1981-June 15, 1982)

Capture Site[1]	Sample Size	Total Number Relocations	Mean Home Range km^2 / Mi^2	Std. Dev. (km)	Range (km)
Beartooth	1	11	.57 / .22		
Keogh	20	80	1.72 / .66	1.22	.01 to 4.70
Robinson Draw	7	25	1.33 / .51	.56	.01 to 1.52
Magpie	18	80	1.42 / .55	.77	.01 to 2.95
Dean	15	68	.92 / .36	.29	.02 to 1.02
Kirch	1	3	1.67 / .65		

[1]Total number of neckbanded individuals for which at least three relocations were obtained.

Winter-spring home range sizes for individual mule deer collared in 1981 were generally smaller in 1981-82 (Table 7) than during the previous year (Tables 3 and 4). Winter range movements during the 2 years were probably similar. However, more severe weather conditions during the 1982 spring appeared to limit movements and retard the onset of migration to summer range. Mean home range areas calculated for neckbanded deer (Table 8) were similar to those observed for radio-collared individuals (Table 7). However, a greater degree of mobility is indicated by observations of neckbanded deer from Keogh site (Fig. 3), than is demonstrated by radio-collared individuals from this site.

Beartooth unit does #309 and #109 did not leave their winter range until the end of May. The transmitter worn by doe #308 failed in May. Weather conditions precluded relocating does #309 and #109 until July 24, when they were relocated near the Slough Creek Campground in Yellowstone National Park. Keogh unit buck #101 remained in the Horseman Flats area until the third week of June.

The most extensive winter-spring movements were exhibited by deer of the Limestone winter range unit, marked at the Robinson Draw site (Table 7). During April and May, 12 of 25 marked individuals were observed feeding in the Hertzler hayfields in the vicinity of the proposed mill site. (A neckbanded adult buck from the Keogh unit was also observed on the Hertzler hayfields in May). On April 14 a neckbanded yearling buck was observed on "Meyers Creek Hill" (immediately north of the Meyers Creek Ranger Station), 9 km (5.5 mi) northwest of the trap site. By the first week of May, buck #307 and three other neckbanded bucks had been observed in the Meyers Creek Hill vicinity. Three additional radio-collared Robinson individuals (does #107, #302 and #304) and at least five neckbanded deer were in this vicinity by May 25. On June 10, buck #307 and a neckbanded buck were observed in the Dry Fork of the East Boulder, approximately 18 km (11 mi) northwest of their capture site, while the remaining four radio-collared Robinson Draw deer and at least eight neckbanded individuals remained in the Meyers Creek-Lodgepole Creek vicinity. By June 22, does #107, #302 and #304 had moved to higher elevations in Dead Indian Creek. At the date of this report it is speculated that some of these marked Robinson Draw deer may have crossed the divide to summer in drainages of the East Boulder, including the Dry Fork. Continued monitoring of marked Robinson Draw deer will be con-conducted by MDFWP to determine the year-long range of this herd.

In March 1982, 13 mule deer were trapped and marked in the Meyers Creek and Castle Creek (Picket Pin Ranch) vicinity as part of a big game study funded by Stillwater PGM. A total of seven deer were neckbanded at the Meyers Creek site and six at the Castle Creek site. Individuals marked at the Picket Pin site remained in that area during the winter and spring. However, two individuals marked at the Meyers Cr. site traveled to the Hertzler hayfield-Robinson Draw vicinity during the third week of April and remained until mid-May.

Observations of neckbanded mule deer during the period of study supplemented distribution data obtained from radio-marked individuals. A brief summary of

sightings outside the boundaries of herd ranges used by radio-marked individuals follows:

During an April 23, 1982 spring helicopter survey, three neckbanded Keogh deer (two adult does, one yearling doe) were observed in the Bad Canyon Creek drainage (White Draw), approximately 8 airline km (5 mi) northeast of where they were marked. A neckbanded yearling Keogh buck was observed in Blind Sheep Creek (approximately 4.5 airline km (3 mi) northwest of the trap site) during the same survey. These observations suggest that some deer that winter on the Keogh unit may migrate to the Bad Canyon vicinity and points north and northeast to spend the remainder of the year. A neckbanded yearling Keogh buck mule deer was observed in early June on the Stillwater-Slough Creek Divide, at the head of Rock Creek (36 km (22.5 mi) southwest of the trap site). During May 1982 four neckbanded individuals were observed on the ridge north of Mountain View Lake (7 km/4.5 mi to the southwest) and another at the head of Pass Creek (8.5 km/5.5 mi to the northwest), indicating dispersal or migration to points to the northwest and northeast, also. These spring observations of neckbanded individuals indicate a more extensive year-long herd range than has been documented through surveillance of radio-marked deer from the Keogh unit.

A yearling Magpie doe was observed in the vicinity of the North Fork of Grove Creek, approximately 14 airline km (9 mi) northeast of her capture site. Whether this movement represents dispersal or migration is unknown.

In November 1981 a hunter reported seeing a neckbanded buck from the Magpie unit in the Dry Fork of the East Boulder. A yearling Magpie buck was observed several times on the East Boulder, in the vicinity of Anderson Springs, during the 1981-82 winter. This movement represents dispersal of approximately 32 airline km (20 mi). It is not known if these sightings were of the same individual, as the collar symbols could not be verified for the November sighting.

A yearling Dean buck was observed on East Rosebud Creek (Mackay Ranch) by hunters several times during the fall of 1981. This represents dispersal of

approximately 13 airline km (8 mi) from the trap site. This individual remained in that vicinity during the 1981-82 winter.

Population Characteristics

Mule deer populations on the study area appear to be healthy and exhibit an upward trend at this time. March 1981 classifications resulted in a fawn: adult ratio of 82:100 (Table 9). Little, if any fawn mortality occured on the study area (hunting districts 520 and 572) during the mild winter of 1980-81 (Simmons et al. 1981). High recruitment of 1980 fawns resulted in a large complement of yearlings in the population in 1981.

Table 9. Winter (March 1981) mule deer classifications, Upper Stillwater study area

Number Classified	Adults	Fawns	Fawns/ 100 Adults	Percent Fawns
2,725	1,494	1,231	82	45

Mule deer classifications obtained from September 1981 through April 1982 are tabulated by herd unit to illustrate population characteristics of each herd segment (Tables 10-12). Cumulative figures indicate general trends for the entire study area (Tables 10-12).

Cumulative fall 1981 classifications indicated a fawn:adult ratio of 61:100 and fawn:doe ratio of 78:100 (Table 10). These figures indicate excellent fawn production in 1981, particularly when the large proportion of unproductive yearling does in the population is taken into consideration. Of total bucks observed, 86% were classified as yearlings and 14% as 2½ or older, indicative of a very young age structure of the male segment of the population.

Cumulative winter 1981-82 classifications indicated an overall fawn:adult ratio of 65:100 (Table 11). A cumulative spring fawn:adult ratio of 48:100 (33% fawns) is a decline from the winter figure of 65:100 (39% fawns), indicating some fawn mortality during April (Table 12). A particularly large decline in

Table 10. Fall 1981 mule deer classifications by herd unit, Upper Stillwater study area (September 15, 1981-November 30, 1981)

Herd Unit	Total	Bucks			Does	Total Adults	Fawns	Fawns/ 100 Does	Fawns/ 100 Adults	Percent Fawns	Bucks/ 100 Does
		Total	Yearling	2+							
Beartooth	38	5	4	1	21	26	12	57	46	32	24
Keogh	136	19	18	1	75	94	42	56	45	31	25
Limestone	306	56	45	11	146	202	104	71	51	34	38
Stillwater	708	80	71	9	334	414	294	88	71	42	24
Cumulative	1,188	160	138	22	576	736	452	78	61	38	28

Table 11. Winter 1981-82 mule deer classifications by herd unit, Upper Stillwater study area (December 1, 1981-March 31, 1982)

Herd Unit	Total	Adults	Fawns	Fawns/100 Adults	Percent Fawns
Beartooth	369	248	121	49	33
Keogh	258	159	99	62	38
Limestone	987	590	397	67	40
Stillwater	476	270	206	76	43
Cumulative	2,090	1,267	823	65	39

Table 12. Spring 1982 mule deer classifications by herd unit, Upper Stillwater study area (April 1, 1982-April 21, 1982)

Herd Unit	Total	Adults	Fawns	Fawns/100 Adults	Percent Fawns
Beartooth	107	71	36	51	34
Keogh	33	23	10	43	30
Limestone	402	292	110	38	27
Stillwater	347	213	134	63	39
Cumulative	889	599	290	48	33

fawn:doe ratios and percent fawns in the population was noted in the Limestone herd segment. (An apparent substantial decrease for the Keogh herd unit (Table 12) could be an artifact of small sample size). Although fawn mortality was not directly observed during field activities, it was noted that weather conditions were conducive to such a loss. Fawn survival appeared to be highest on the Beartooth winter range unit.

Comparison of age composition of individual herd segments from fall 1981 through spring 1982 does indicate differences in fawn production among winter range units. Fawn:adult ratios and percent composition of fawns was less variable among the Beartooth, Keogh and Limestone units than between any of these herd segments and the Stillwater segment. These figures were consistently higher for the Stillwater unit during all seasons, suggesting that this herd segment is characterized by higher productivity, survival or both.

Sex and age classes of mule deer captured on the study area in March 1981 are presented in Table 13. Only two mature males (2+) were captured. General winter observations and aerial surveys also indicated that few bucks older than 2½ were present on the study area. The 50:50 male:female ratio observed for captured fawns indicated that sufficient numbers of male fawns were being produced with the potential of being recruited into the population. Low numbers of mature bucks observed on the study area may be due to differential distribution and/or differential mortality of older males.

Sex and age distribution of Upper Stillwater mule deer obtained from October 1981 through April 1982 is presented in Table 14. Although a paucity of older bucks in the population was indicated in the 1982 sample, it was evident that a good number of yearlings had been recruited into the 2½ age class. Age classes of captured females indicates a population with a young age structure with 48% of the sample between 2½ and 6½ years of age, 23% yearlings and 15% fawns. (Age structure information obtained at check stations is biased against fawns.)

Table 13. Sex and age classes of captured mule deer, Upper Stillwater study area, March 1981

	Tot	Fawns	1½	2½	3½	4½	5½	6½	7½	8½	9½	10+
♂	40	34(85)[1]	4(10)	2(5)								
♀	103	33(32)	8(8)	9(9)	12(12)	13(13)	7(7)	8(8)	5(5)	4(4)	1(1)	3(3)

[1]Percentage of total males/females.

Helicopter surveys were conducted April 14-15, 1981 and April 22-23, 1982 to determine mule deer population density on the study area. Helicopter survey units are illustrated in Fig. 7. Population estimates were determined on the basis of the proportion of marked individuals observed, using a Lincoln-Petersen Index (Overton and Davis 1969) (Tables 15 and 16). Since general habitat types in many survey units are similar, it was assumed that aerial observability, and therefore survey efficiency, was also comparable in these units.

Boundaries of two survey units (#5 and #8) were changed in 1982, resulting in a 12% increase in the total area surveyed. The 1982 survey indicated that there were approximately 5,900 mule deer present in the study area, a 50% increase from the 1981 estimate of 3,924 (Table 16). Overall density increased from 13 deer/km^2 (33 deer/mi^2) in 1981 to 17 deer/km^2 (43 deer/mi^2) in 1982. Survey unit #1 (corresponding to the Stillwater mule deer herd unit) exhibited the highest deer densities both years (28 deer/km^2 in 1981, 32 deer/km^2 in 1982). Survey unit #7 (including a portion of the Limestone herd unit) also exhibited a relatively high density of 29 deer/km^2 in 1982. Deer density observed in 1982 increased in all survey units except three: it remained nearly the same in survey unit #2 (Keogh herd unit), and decreased substantially in survey units #4 and #5. A portion of survey unit #2 (approximately 1.5 km^2 (1 mi^2) of fairly rugged terrain was surveyed from the ground rather than with the helicopter, per the landowner's request. This undoubtedly resulted in an artifically low count. The decrease observed in survey unit #5 may be due to the fact that the

Table 14. Sex and age classes of Upper Stillwater mule deer, October 1981-April 1982

Sex	Total	Fawns	1½	2½	3½	4½	5½	6½	7½	8½	9½	10+	Unknown Adult
Males	153	32(21)[2]	88(58)	24(16)	1(1)	2(1)	2(1)	1(1)	0	0	0	1(1)	2(1)
Females	175	26(15)	40(23)	20(11)	20(11)	16(9)	19(10)	12(7)	7(4)	6(3)	5(3)	2(1)	3(2)

[1]Sample size = 328

Check station (hunting districts 520, 521, 572): 226
Drive netting (March 1982) : 85
Road kills and other mortalities : 17

[2]Percentage of total males/females.

Table 15. Upper Stillwater mule deer population estimates and densities by helicopter survey unit, mid-March 1981

Survey Unit	Total No. Marked Deer	Deer Counted	Population Estimate	Area Surveyed (km^2/mi^2)	Density (Deer/km^2 & mi^2)		Efficiency[1]
1	100	868	1,157	41/16	28	72	75%
2	41	301	443	38/15	12	30	68%
3	0	51	71	18/7	4	10	(Estimated 72%)
4	0	210	292	33/13	9	22	(Estimated 72%)
5	0	236	328	15/6	22	55	(Estimated 72%)
6	0	353	490	92/36	5	14	(Estimated 72%)
7	0	592	822	46/18	18	46	(Estimated 72%)
8	0	231	321	23/9	14	36	(Estimated 72%)
Total	141	2,842	3,924	306/120	13	33	

[1]Percentage of known marked deer observed.

Table 16. Upper Stillwater mule deer population estimates and densities by helicopter survey unit, mid-March 1982

Survey Unit	Total No. Marked Deer	Deer Counted	Population Estimate	Area Surveyed (km^2/mi^2)	Density (Deer/km^2 & mi^2)		Efficiency[1]
1	98	758	1,318	41/16	32	82	57%
2	53	232	406	38/15	11	27	57%
3	0	71	124	18/7	7	18	(Estimated 57%)
4	0	116[1]	204	33/13	6	16	(Estimated 57%)
5	0	458*[2]	916*	54/21*	17*	44*	(Estimated 50%)
6	0	504	884	92/36	10	25	(Estimated 57%)
7	22	645	1,351	46/18	29	75	48%
8	14	603*	697*	28/11*	25*	63*	95%
Total	187	3,387	5,900	350/137	17	43	

[1]Percentage of known marked deer observed.

[2]Surveys conducted by Super Cub instead of helicopter.

*Boundary of survey unit enlarged from 1981.

larger survey area included habitats where deer densities were substantially lower than noted in 1981. Survey unit #4 is considered to be a marginal wintering area for mule deer. The decline in deer numbers observed in this unit may have been due to movement of deer to adjacent wintering areas (survey unit #1) prompted by more severe winter conditions in 1982.

The 50% increase in the number of mule deer estimated to be on the study area from 1981 to 1982 was unexpectedly low. Deer densities in 1981 were considered to be very low due to mild weather conditions which allowed deer to remain on summer or intermediate ranges rather than congregate on traditional wintering areas. Computer modeling (conducted annually since 1978) of the portion of the population in survey units #1 and #6 indicated that as much as one-third of the population did not occupy its traditional winter range during 1980-81. A 50% increase does not account for the number of deer expected in 1981-82, including 1981 fawns as well as deer which wintered elsewhere in 1980-81. If numbers of deer anticipated on winter ranges in the Upper Stillwater during the 1981-82 winter were reasonable (in excess of the 50% increase actually observed), two factors may account for the lesser increase observed. One possibility is that the 1981-82 winter was not severe enough to force all deer to traditional wintering areas. Another possibility is that significant numbers of mule deer may be emigrating to adjacent areas with lower deer densities. Hamlin (1982) has documented emigration of a substantial proportion of yearling females from a population in the Missouri Breaks that is experiencing a rapid increase, an apparent reaction to population density.

The study area covers portions of hunting districts 520 and 572. The 1980 deer harvest statistics for those districts, as determined by the hunter questionnaire survey, are presented in Table 17.

A total of 815 general "A" tag holders hunted in hunting district 520 during 1980 with a success rate of 40% and 7.3 days afield/deer harvested. Of the 98 either-sex permit holders that hunted, 23 took bucks and 21 harvested does or fawns for a 45% success rate (Simmons et al. 1981).

Table 17. The 1980 deer harvest statistics for hunting districts 520 and 572, as determined by the hunter questionnaire survey[1]

Hunting District	Total Harvest	Antlered No.	Antlered %	Ant'less No.	Ant'less %	Unknown No.	Unknown %	Mule Deer No.	Mule Deer %	Whitetails No.	Whitetails %	Unknown No.	Unknown %
520	330	295	89	30	10	1	0	282	85	43	15	5	2
572	447	313	70	125	40	0	0	377	84	60	16	10	2

[1]Data from Simmons et al. 1981.

A total of 908 hunters hunted in hunting district 572 during 1980 with 49% success and 4.8 days afield/deer harvested. The 9-day either-sex season resulted in the harvest of 96 antlerless mule deer, which comprised 25% of the mule deer harvest.

Next to hunting, road kills accounted for the majority of observed mule deer mortality on the study area. It must be emphasized that extensive and systematic searches for road-killed deer were not conducted. However, obvious roadside mortalities were examined during the course of other field activities. Observed road kills during winter, spring and fall seasons included 13 does, 2 bucks and 8 fawns. Other observed mortalities included one mountain lion kill, two coyote kills, one suspected poaching and four of undetermined causes.

Verified mortality of marked deer on the study area is as follows: ten hunter kills (three adult does, seven yearling bucks), three road kills (three adult does) and three of undetermined causes (one adult buck, two buck fawns).

A total of 29 individuals neckbanded during the 1980-81 winter could not be accounted for during the 1981-82 winter (8 adult does, 6 yearling does, 15 yearling bucks). The absence of these individuals in 1982 is probably due to unreported mortalities as well as emigration.

Potential Impacts

There is a high potential for direct impacts to deer wintering in the immediate vicinity of the Mouat Mine (Beartooth herd segment). Impacts would be due to disturbance from increased human activity associated with the mining

operation, vehicular traffic, noise and removal of a portion of the winter range (reclamation) from stacking of mine spoils.

Migratory movement of the three radio-collared does from the Beartooth herd unit are indicative of the migratory tradition of the entire herd. These deer have special value and national significance in that they are an important asset to Yellowstone National Park where they are extensively viewed and photographed. The value of this herd is certainly enhanced by the unique recreational opportunities it affords the public. Care must be taken to minimize disturbance and stress of this wintering population from mine-related activity.

A high potential for direct impacts also exists for mule deer of the Limestone herd segment, particularly individuals that winter in the Robinson Draw-Hertzler Ranch vicinity. As many as 130 mule deer have been observed feeding in the immediate vicinity of the proposed Hertzler mill site during early spring. If the milling process and associated human activity should render this area unsuitable for mule deer, the loss of this portion of range could have a significant impact on the herd.

Although delineation of the year-long herd range of mule deer marked at the Robinson Draw site is not complete at this report date, preliminary findings indicate that at least a portion of this herd segment summers in the vicinity of the Dry Fork of the East Boulder River. Stillwater PGM has proposed a mining operation for that area, similar to the one proposed by Anaconda Minerals Company in the Upper Stillwater. If both operations materialize, it it likely that this herd segment would be significantly impacted on both its winter and summer ranges. Continued monitoring of marked Robinson Draw deer will be conducted by MDFWP to define year-long movement patterns of Robinson Draw deer. Potential combined impacts of these two projects on this population should be addressed in final EIS documents for both projects.

Indirect impacts of mining which will affect all herd segments in the study area include land development (subdivisions and "ranchettes") and increased incidence of road kills by ore trucks and other mine-related traffic.

It is anticipated that increased hunting pressure and/or poaching will also be by-products of the influx of people employed by the mine. Removal of habitat through land development is perhaps the most insidious but irreversible of these indirect impacts.

Recreational and aesthetic values of the mule deer population of the Upper Stillwater Valley are substantial. Care should be taken to insure that this resource is perpetuated for the enjoyment of future generations.

White-tailed Deer

History

Cooney (1936) described white-tailed deer as "fairly abundant" in the Beartooth Mountains in 1890, declining to "very scarce" by 1910. He stated that the last white-tailed deer sighting in or near the Beartooth Range was reported in 1925.

The Montana Department of Fish and Game transplanted white-tailed deer to the Beartooth Mountains from 1945 through 1947. In 1945 and 1946, 22 and 21 individuals, respectively, were released along the Stillwater River in the vicinity of the Beartooth Ranch. By 1949, the Stillwater population was estimated at 100 deer (Stoneberg 1977).

Stoneberg (1977) described the range of white-tailed deer in the Upper Stillwater as encompassing the Stillwater River between the mouths of Nye Creek and Little Rocky Creek and up the West Fork of the Stillwater River to about the middle of Horseman Flats. He also noted that whitetails were occasionally observed in the Sioux Charley Lake and Big Park vicinities. During the course of this study, whitetails have been observed as far south as the Beartooth Ranch and as far north as Dead Indian Creek, in addition to that area described by Stoneberg. Local residents in the Upper Stillwater report that the white-tailed deer population has exhibited significant range extension during the last several years.

Movements and Distribution

Trapping efforts resulted in the marking of 40 whitetails during the month

of February 1982. Seven individuals (six does, one buck) received radio collars (Table 18) and the remainder were fitted with individually recognizable neckbands. Trapping effort was concentrated on the stretch of the Stillwater River between the Keogh Ranch and the mouth of Little Rocky Creek, including the lower reaches of the West Fork near its junction with the main Stillwater River. Limited trapping was also conducted on Little Rocky Creek, approximately ½ mile southeast of the Nye cemetery.

Table 18. Capture locations and collar descriptions for radio-collared white-tailed deer, Upper Stillwater study area, February 1982

Sex	Age	Animal ID (Band Channel)	Collar Description	Capture Site
Female	9-10½	102	White/red (PVC)	Keogh
Female	1½	106	Solid White (belting)	Keogh
Male	1½	112	Blue/white (belting)	Keogh
Female	3-4½	103	Red/white (PVC)	Ekwortzel
Female	7½	306	Solid green (PVC)	Ekwortzel
Female	3-4½	108	Solid red (PVC)	Winge
Female	3-4½	301	White/black (PVC)	Winge

Winter and spring home range sizes for radio-collared white-tailed deer are presented in Table 19. All radio-marked individuals remained in the vicinity of their capture sites during the winter season, with only one individual (#108 ♀) having a seasonal home range greater than 2.5 km^2 (1 mi^2). However, observations of neckbanded individuals indicated that some whitetails were quite mobile during winter, traveling as far as 2 miles from their capture sites.

Table 19. Home range sizes for radio-collared white-tailed deer marked on the Upper Stillwater study area, winter and spring 1982

Animal ID	Polygon Home Range (km^2/mi^2)		
	Winter 2/1/82-4/15/82	Spring 4/16/82-6/15/82	Winter-Spring 2/1/82-6/15/82
102 ♀	.7/.3 (6)[1]	2.8/1.1 (8)	3.9/1.5 (14)
106 ♀	1.0/.4 (8)	16.4/6.4 (12)	18.0/6.9 (20)
112 ♂	Only two relocations	.3/.1 (8)	1.1/.4 (10)
103 ♀	1.0/.4 (9)	Essentially no movement observed	1.4/.5 (16)
306 ♀	1.1/.4 (11)	.4/.2 (5)	1.6/.6 (16)
108 ♀	3.3/1.3 (9)	23.4/9.0 (5)	93.4/36.0 (14)
301 ♀	2.4/.9 (6)	9.5/3.7 (3)	45.2/17.4 (9)
Cumulative	16.2/6.2	222.4/85.9	276.6/106.8

[1]Number of relocations.

Most radio-marked whitetails exhibited increased movement during the spring season (Table 19). Doe #106 moved 8 airline km (5 mi) northwest of her capture site early in June to Castle Creek. Does #108 and #301 could not be located between mid-April and mid-May. Both were finally relocated on a May 26 flight; doe #301 on Jack Stone Creek, 23.5 airline km (15 mi) northeast of Nye and doe #108 near Huntley Butte, 35 airline km (22 mi) northeast of Nye. The remaining four radio-marked individuals remained in the Upper Stillwater Valley. Winter-spring ranges of radio-collared individuals are illustrated in Fig. 8.

Spring sightings of neckbanded whitetails gave further insight to year-long distribution of the Upper Stillwater white-tailed deer population. During a June flight, three neckbanded whitetails (one adult doe, one yearling doe, one yearling buck) were observed in the company of doe #108 near Huntley Butte. In late May a marked adult doe was observed near the Red Lodge airport, 51 airline km (32 mi) southeast of Nye. Neckbanded whitetails were also observed on Red Lodge Creek near Sheep Mountain (34 km (21.5 mi) southeast of Nye) and on Willow Creek near the Missouri cutoff road (46 km (28.5 mi) southeast of Nye) during the month of May. Mean winter-spring home range size for neckbanded whitetails was 12.39 km^2 (4.78 mi^2), (N = 30, std dev. = 13.88 km, range; .02 - 70.46 km^2).

Although movements of Upper Stillwater white-tailed deer have been monitored for only 5 months, preliminary findings indicate that the year-long range of this population covers an extensive geographical area (Figure 9). Continued monitoring of marked individuals will be conducted by MDFWP to further delineate the year-long range of this population.

Population Characteristics

The white-tailed deer population of the Upper Stillwater appears to be healthy, exhibiting an upward trend at this time. The study area covers portions of hunting districts 520 and 572. Spring 1981 surveys of these hunting districts indicated a fawn:adult ratio between 81 and 86:100, the highest observed in

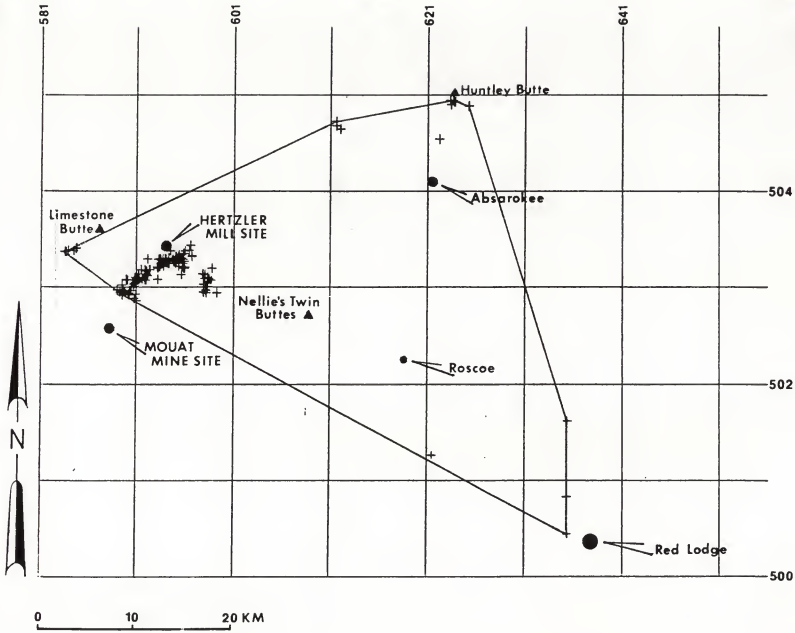

Fig. 9. Winter-spring herd range for marked Upper Stillwater whitetails, February-July 1982.

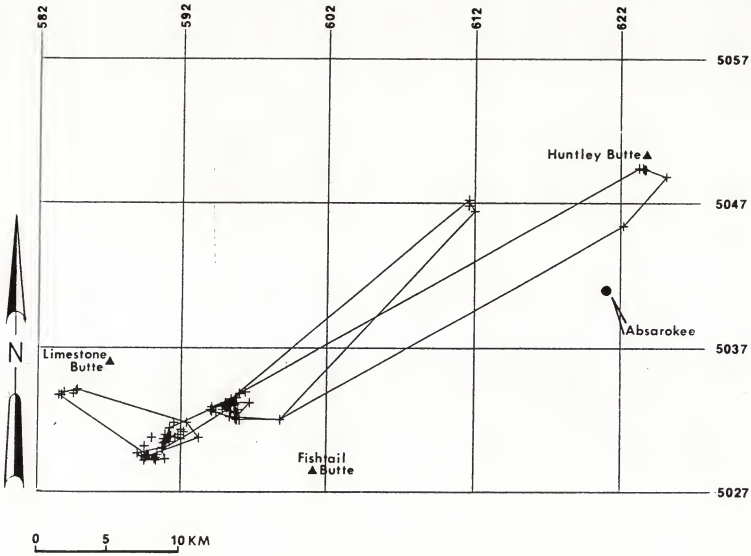

Fig. 8. Winter-spring distribution of radio-marked white-tailed deer, Stillwater study area - February-July 1982.

recent years (Simmons et al. 1981). Little or no fawn mortality occurred on the study area during the 1980-81 winter. Overwinter fawn mortality in hunting district 520 has ranged between 26 and 35% in previous years (Simmons et al. 1981).

Fall 1981 white-tailed deer classifications on the study area yielded a fawn:adult ratio of 102:100 and a fawn:doe ratio of 125:100, indicative of excellent fawn production and survival in 1981 (Table 20).

Table 20. Fall (September-November) white-tailed deer classification, Upper Stillwater study area, 1981

No. Classed	Adults	Fawns	Does	Bucks	Uncl. Adults	Fawns/ 100 Adults	Fawns/ 100 Does	% Fawns
89	44	45	36	5	3	102	125	50

Winter 1981-82 classifications are presented in Table 21. The extraordinarily high fawn:doe ratio recorded in December is likely a function of small sample size. The apparent decline in fawn:adult ratios from December to February, suggestive of fawn mortality, is misleading. However, the 23% decline in fawn:adult ratios from January to March was probably indicative of at least some fawn mortality, though no other evidence of mortality was observed.

Table 21. Winter white-tailed deer classification, Upper Stillwater study area, 1981-82

Month	Number Classified	Adults	Fawns	Fawns/ 100 Adults	Percent Fawns
December	29	11	18	164	62
January	100	51	49	98	49
February	377	223	154	69	41
March 1-15	220	130	90	69	41

Ordinarily there should be no difficulty in distinguishing fawns from adults by visual observation during winter months, but a substantial proportion

of 1981 white-tailed deer fawns in the Upper Stillwater population were exceptionally large, making accurate classification difficult. It is believed that good fawn growth through the winter resulted in an increasing number of fawns being mistaken for adults as the winter progressed. The exceptionally large size of these fawns is indicative of the health of the population.

Sex and age classes of captured whitetails are presented in Table 22. The discrepancy in numbers of male fawns compared to female fawns was unexpected and is open to speculation. It is possible that the apparent absence of 2½-year old animals in the population could be due to error in age estimation of some individuals in the 3-4½ age class

Table 22. Sex and age classes of captured white-tailed deer, Upper Stillwater study area, February 1982

Sex	Total	Age							
		Fawn	1½	2½	3-4½	5-6½	7-8½	9-10½	Unknown Adults
Male	18	13(72)[1]	3(17)	0	1(6)	1(6)	0	0	0
Female	23	6(26)	4(17)	0	6(26)	1(4)	3(13)	2(9)	1(4)

[1]Percentage of total males/females.

Helicopter surveys were conducted March 27 and April 22, 1982 to obtain a population estimate for the Upper Stillwater white-tailed deer population. Boundaries of the survey area are illustrated in Figure 10. Population estimates were determined on the basis of the proportion of marked individuals observed, using a Lincoln-Petersen Index (Overton and Davis 1969) (Table 23). It was estimated that 251 to 258 whitetails were present on the 33 km^2 (13 mi^2) area, yielding a density estimate of eight deer/km^2 (twenty deer/mi^2).

The 1980 deer harvest statistics for hunting districts 520 and 572, as determined by the hunter questionnaire are presented in Table 24. White-tailed deer made up 15% of the total deer harvest in hunting district 520, with an average hunter effort of 4.1 days/deer harvested. Whitetails made up 16% of

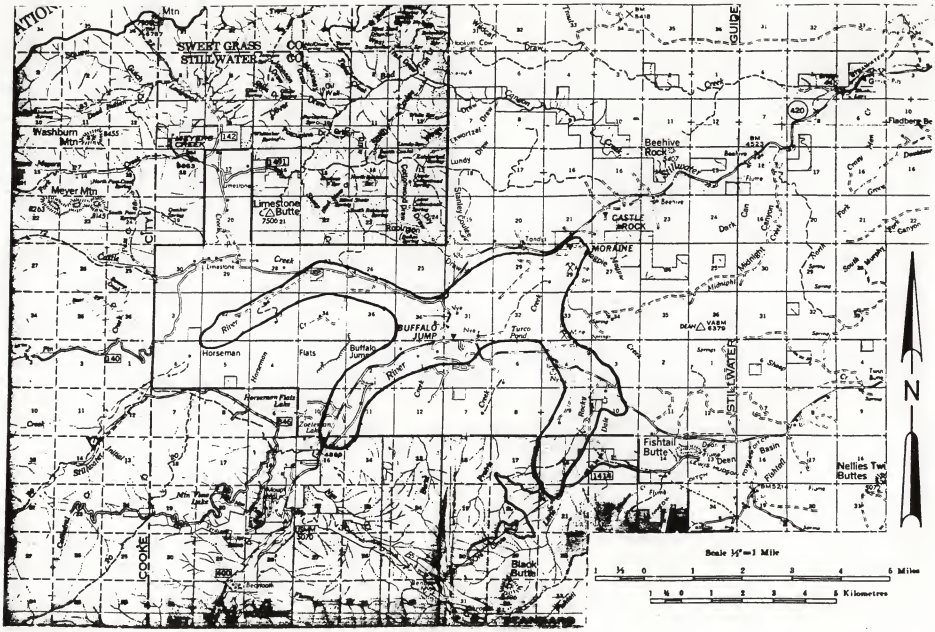

Fig. 10. White-tailed deer aerial survey area, Upper Stillwater study area, 1982.

the total deer harvest in hunting district 572, with an average hunter effort of 4.5 days/ deer harvested (Simmons et al 1981).

Table 23. Upper Stillwater white-tailed deer population estimates and densities, 1982

Survey Date	Deer Counted	Population Estimate[1]	80% Confidence Interval	Density (Deer/km^2 & mi^2)		Efficiency[1]
3/27/82	91	251	176 <μ <326	8	19	35%
4/22/82	144	258	195 <μ <321	8	20	55%

[1]Percentage of known marked deer observed.

Table 24. The 1980 deer harvest statistics for hunting districts 520 and 572, as determined by the hunter questionnaire survey[1]

Hunting District	Total Harvested	Antlered No.	Antlered %	Ant'less No.	Ant'less %	Unknown No.	Unknown %	Mule Deer No.	Mule Deer %	Whitetails No.	Whitetails %	Unknown No.	Unknown %
520	330	295	90	30	10	1	0	282	85	43	13	5	2
572	447	313	70	125	30	0	0	377	84	60	14	10	2

[1]Data from Simmons et al. 1981.

Observed winter-spring mortalities of white-tailed deer on the study area were limited to one road kill (a yearling buck) and a neckbanded doe (10+ years old) which was of undetermined causes.

Potential Impacts

It is anticipated that haul road traffic would have the most significant impact on the white-tailed deer population of the Upper Stillwater. The entire length of the proposed haul route between the Mouat mine and the Hertzler mill site is within white-tailed deer habitat, and is subject to deer crossings. A substantial increased incidence of road kills along the haul route would be expected. Those areas with a particularly high incidence of crossings are delineated in Fig. 11. The West Fork of the Stillwater, a major travel corridor for whitetails, is the most heavily used crossing along the haul route. It is not

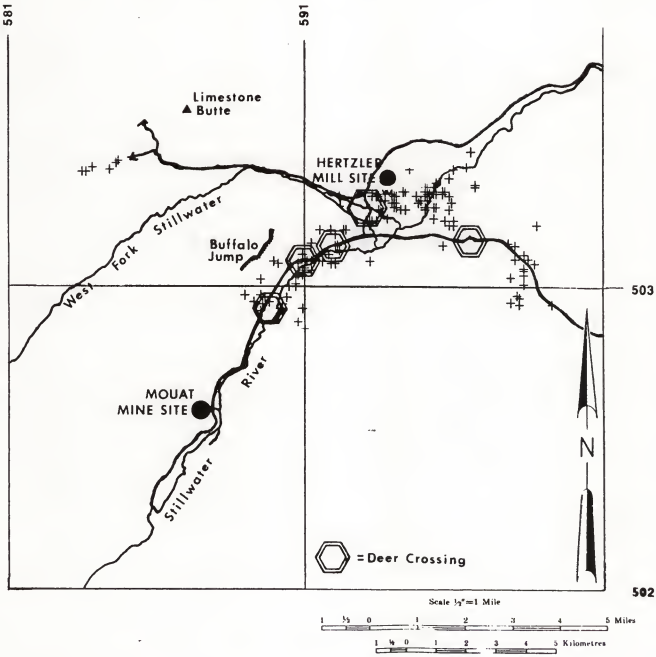

Fig. 11. Major white-tailed deer road-crossing areas, Upper Stillwater study area (+'s denote sightings of marked whitetails only).

known whether heavy mine-related traffic along the haul route would affect movements, distribution and habitat use by whitetails.

White-tailed deer were observed to use the vicinity of the Hertzler mine site, but not in large numbers. However, the south-facing slope of Bush Mountain and the ridge extending to the east, as well as the area between Bush Mountain and the Nye road receives heavy use. It is possible that activity associated with the milling operation could render these areas less suitable for whitetails.

Elk

History

Very little data is available on the early history of the Upper Stillwater elk herd. Large numbers of antlers observed on Horseman Flats by early settlers indicated that the area was a historical elk wintering area and that elk had been abundant in the early and mid-1900's (Stoneberg 1977). Forest Service game counts during the winters of 1935-36 and 1936-37 made no mention of elk on Horseman Flats or the immediate vicinity (Stoneberg 1977), but several long-time local residents maintain that a small herd used this area during the late 1930's and early 1940's (W. Keogh, P. Winge, pers. comm.). Sporadic elk sightings during the late 1940's through the 1960's suggest that a small group of elk intermittently used the Horseman Flats-Picket Pin Creek wintering area until the late 1960's when the herd suddenly increased (Stoneberg 1977). Population characteristics of this herd have been monitored annually since 1970-71. Previous intensive studies of this population were conducted by Knapp (1973) and Stoneberg (1977).

Movements

Capture efforts resulted in the marking of six elk. All elk captured (one yearling bull and five adult cows) were fitted with radio transmitter collars (Table 25).

Major winter elk range units in the Upper Stillwater are illustrated in Fig. 12. Seasonal and year-long home range sizes for radio-collared elk are summarized

in Table 26. Surveillance of radio-collared individuals indicates a year-long herd range of at least 440 km^2 (170 mi^2) (Fig. 13), with individual yearly home range size varying from 233 km^2 (90 mi^2) for bull #110 to 67 km^2 (26 mi^2) for cow #407. Cumulative seasonal ranges for marked elk during the study period are illustrated in Fig. 14 and 15.

Table 25. Capture locations and collar descriptions for radio-collared elk, Upper Stillwater study area, 1981

Sex	Age	Animal ID (Band/Channel)	Collar Description	Date of Capture	General Location of Capture
♂	1½	110	Solid blue (belting)	3-3-81	Meyers Creek
♀	Adult	201	Solid green (PVC)	3-3-81	Meyers Creek
♀	Adult	204	Green/white (PVC)	3-4-81	Picket Pin
♀	Adult	205	Solid red (PVC)	3-4-81	Picket Pin
♀	Adult	207	Red/white (PVC)	3-4-81	Picket Pin
♀	Adult	407	Solid yellow (belting)	4-17-81	Horseman Flats

A brief summary of year-long movements of each radio-collared individual follows:

1. Bull #110: Left the Lodgepole wintering area in late May 1981 and traveled to Elk Creek (in the Boulder River drainage) via Lower Deer Creek. By June 25 he was in Placer Basin; in early July at the head of Pass Creek and during late July and August in the Picket Pin-Iron Mountain vicinity. He spent September on the Lodgepole wintering area, moving to the head of Lodgepole Creek in November and to the head of Teepee Creek in Bad Canyon in December. This individual spent the 1981-82 winter near the head of Blind Bridger Creek,

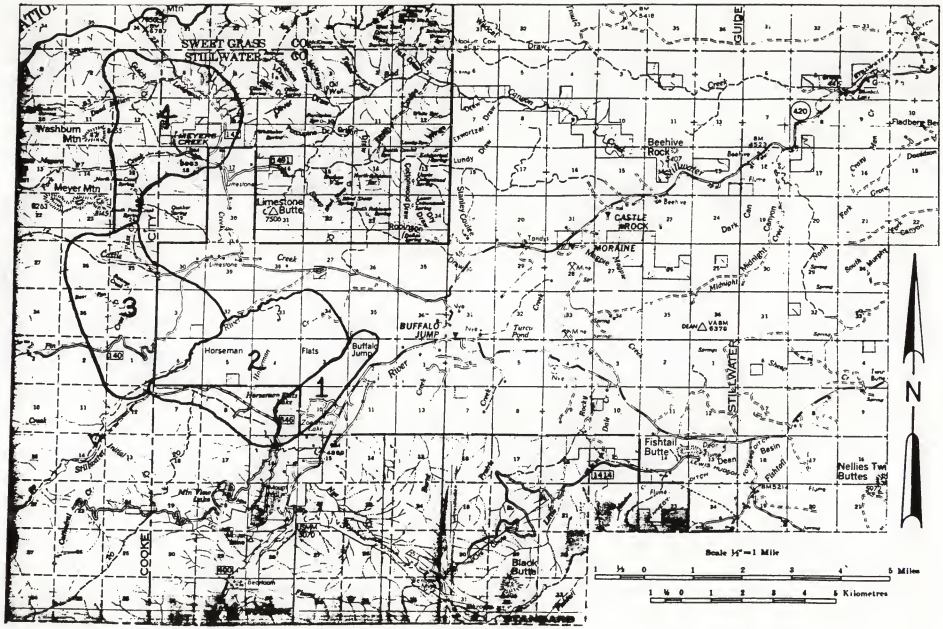

Fig. 12. Major elk winter range units, Upper Stillwater study area (1 = Main Stillwater, 2 = Horseman Flats, 3 = Picket Pin, 4 = Lodgepole).

Table 26. Home range sizes for radio-collared elk marked on the Upper Stillwater study area, 1981-82

Animal ID	Polygon Home Range (km^2/mi^2)				
	Winter-Spring 3/1/81-6/15/81	Summer-Fall 6/16/81-11/30/81	Winter 12/1/81-4/15/82	Spring 4/16/82-6/15/82	Year-Long 3/1/81-8/30/82
110 ♂	30.0/11.6(8)[1]	83.1/32.1(11)	1.6/.6(6)	12.4/4.8(6)	232.7/89.8(32)
201 ♀	2.9/1.1(7)	Transmitter failed 5/81	.4/.2*(5)	4.4/1.7*(5)	8.9/3.4*(20)
204 ♀	78.2/30.2(7)	33.4/12.9(9)	5.9/2.3(6)	6.9/2.7(7)	132.9/51.3(31)
205 ♀	20.9/8.1(7)	42.0/16.2(9)	26.4/10.2(7)	36.6/14.1(11)	242.0/93.4(36)
207 ♀	7.4/2.9(11)	10.7/4.1(9)	20.4/7.9(6)	18.0/7.0(9)	98.1/37.9(37)
407 ♀	2.3/.9(4)	30.8/11.9(8)	5.4/2.1(5)	9.4/3.6(8)	66.9/25.8(27)
Cumulative	311.2/120.1	152.5/58.9	104.7/40.4	184.6/71.2	439.6/169.7

[1]Number of relocations.

*Area calculation based on visual observations only.

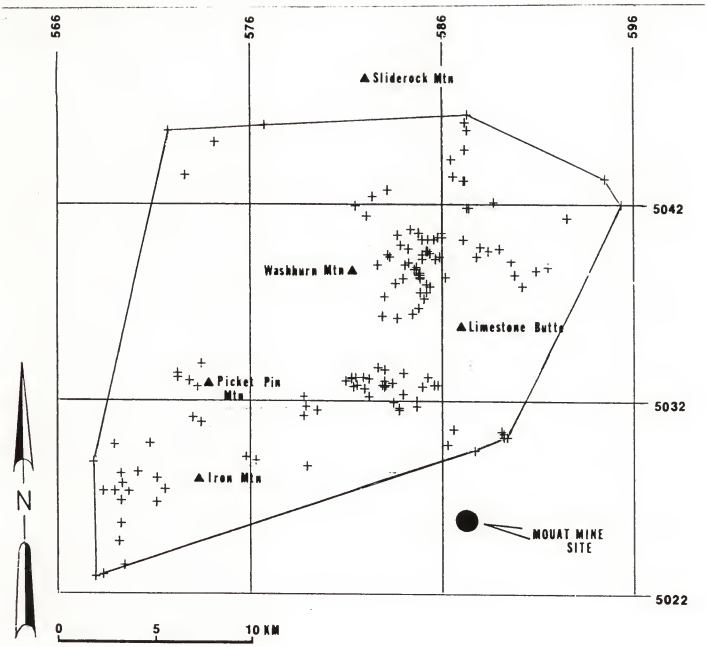

Fig. 13. Year-long herd range for radio-marked elk, Upper Stillwater study area, 1981-82.

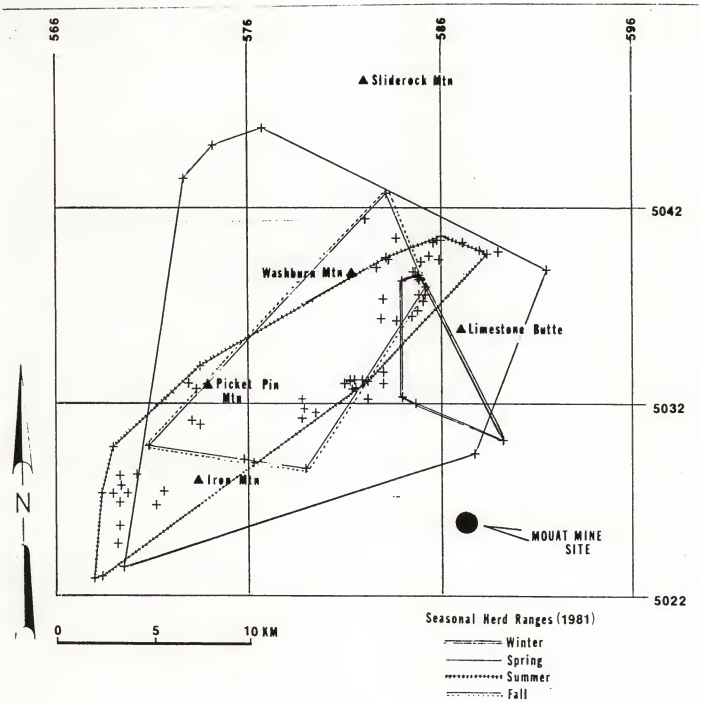

Fig. 14. Seasonal herd ranges for radio-marked elk, Upper Stillwater study area, 1981.

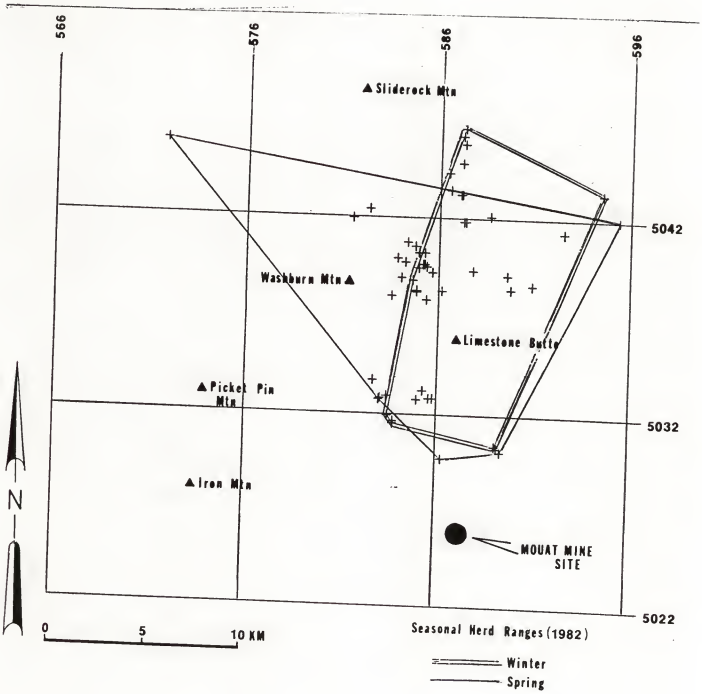

Fig. 15. Winter and spring 1982 herd ranges for radio-collared elk, Upper Stillwater study area.

approximately 8 km (5 mi) northeast of the Lodgepole wintering area where he was marked the previous winter. He returned to the Lodgepole vicinity early in May 1982, remaining for about 2 weeks before traveling to the head of Lower Deer Creek. Bull #110 was relocated in Elk Creek during a July 10 flight.

2. Cow #201: The transmitter worn by this individual failed in May 1981, but periodic sightings suggested that she remained in the vicinity of the Lodgepole wintering unit during 1981. She remained in the Lodgepole Creek vicinity during the 1981-82 winter and spring seasons also.

3. Cow #204: Traveled from the Picket Pin unit to Pass Creek in early June 1981, then to the Trail Creek-Breakneck Plateau where she summered. She returned to the Picket Pin area in early November and remained there for the duration of the 1981-82 winter and spring. She was observed several times in late April on the Main Stillwater winter range unit (north of Cathedral Mountain subdivision).

4. Cow #205: Traveled from the Picket Pin unit to Bear Pen Creek in mid-May 1981, to Pass Creek in early June, then to the upper end of Placer Basin in July. She spent August and September in the vicinity of Bear Pen Creek and was relocated on the Lodgepole unit early in November. She was located in Bad Canyon early in December, where she remained during the 1981-82 winter, ranging between Oliver Draw and Trail Draw. She spent the first 3 weeks of May in the Lodgepole Creek vicinity and was observed on the Picket Pin unit May 21, in Bad Canyon (Smith Coulee) May 26 and back in the Lodgepole vicinity June 10.

5. Cow #207: Was marked on the Picket Pin unit, but moved to the Lodgepole wintering unit soon afterwards. She was relocated in Bad Canyon (Oliver Draw) in mid-May and remained in the Bad Canyon vicinity through the summer and fall. She was relocated at the head of Lodgepole Creek early in November, on the Lodgepole unit early in December and in Bad Canyon in early January 1982, where she remained through June. She ranged between Oliver Draw and Trail Draw and was observed several times in the company of cow #205 (both cows were accompanied by calves).

6. Cow #407: Moved from Horseman Flats to Picket Pin early in June, spending late June and early July in Placer Basin and late July in Bear Pen Creek, returning to Placer Basin in early August. She spent the fall in the Iron Creek vicinity and the 1981-82 winter and spring on the Picket Pin unit. She was observed several times on the Main Stillwater winter range unit (north of the Cathedral Mountain subdivision) during late April and early May 1982.

Distribution

Stoneberg (1977) delineated three winter range units used by the Upper Stillwater elk herd as follows: Picket Pin, Horseman Flats and Main Stillwater (Fig. 12). Stoneberg found that within the Picket Pin unit the main area of elk use lay between Picket Pin Creek and the West Fork, adjacent to the Forest Service boundary and he identified Swamp Creek and Bear Pen Creek as important use areas also. The key area identified on the Horseman Flats unit was the timber edge above the road, including Rabbit Gulch and Horsehead Draw. Key areas delineated on the Main Stillwater unit included the vicinity of Horseman Flats Lake (the Cathedral Mountain subdivision) and adjacent ranch property to the north.

Winter elk distribution observed during the current study has changed dramatically from that observed by Stoneberg, resulting in the delineation of the Lodgepole winter range unit (located north of the Picket Pin unit and northwest of Limestone Butte). This elk winter range is centered around "Meyers Creek Hill" (directly north of the Meyers Creek Ranger Station) and includes slopes and fields adjacent to Lodgepole Creek, Squaw Gulch, Dead Indian Creek and Meyers Creek (Figure 12). Elk use of this area was minimal during the period of Stoneberg's study, but has been increasing dramatically ever since. Observations of radio-collared animals indicated interchange between the Lodgepole and Picket Pin units.

Elk remained on wintering areas until mid-May 1981 and late May 1982. Some dispersal associated with calving occurred from mid-May to mid-June. Stoneberg

(1977) delineated the Rabbit Gulch and Horsehead Draw vicinities of Horseman Flats and the Bear Pen Creek and Swamp Creek vicinities of Picket Pin as major calving areas. Field observations during spring 1981 and 1982 indicated that calving occurred on or immediately adjacent to the Lodgepole unit as well.

Elk distribution among winter range units during the 1980-81 winter was very different from that observed by Stoneberg (1977). Elk use of the Horseman Flats and Main Stillwater units declined dramatically with a concurrent increase in use of the Lodgepole unit (Table 27). Little use of the Horseman Flats unit was observed during any season and use of the Main Stillwater unit was limited to spring, by small numbers of elk.

Table 27. Percentage distribution of elk observations[1] on elk winter range units[2]

Unit	1971-72	1972-73	1973-74	1974-75	1975-76	1980-81
Horseman Flats	100	45	48	4	9	6
Main Stillwater	0	0	10	79	52	8
Picket Pin	0	55	42	17	39	40
Lodgepole	-	-	-	-	-	46
Total	155/5[3]	207/9	683/51	2,484/84	948/44	392/15

[1]Aerial and ground observations combined.

[2]1971-76 data from Stoneberg (1977).

[3]Total number of elk observed/number of observations.

Due to inclement flying weather during the 1981-82 winter, it was not possible to uniformly survey elk winter range to determine exact proportions of the population using each unit. However, ground observations indicated that 62 to 64 elk wintered on the Lodgepole unit and 41 to 47 elk wintered on the Picket Pin unit. Some individuals observed on the Picket Pin unit probably used the Horseman Flats unit to some extent. The maximum number of elk observed on the Main Stillwater unit during late April 1982 was 25.

Elk distribution within the Picket Pin unit during the 1980-81 and 1981-82 winters also contrasted with that observed by Stoneberg (1977). Elk use during this study period was primarily in the Swamp Creek-Bear Pen Creek vicinity, including the ridges east and west of the Picket Pin Ranch hayfields.

Movement from wintering areas to summer ranges occurred from mid-June to mid-July 1981. Bull #101 made extensive movements during the spring and summer seasons, while radio-collared cows exhibited a high degree of individual variability in home range size (Table 26). Surveillance of radio-collared elk during the 1981 summer-fall seasons indicate changes in summer elk distribution trends from those documented by Knapp (1973) and Stoneberg (1977). Summer movements of marked Stillwater elk indicate increased use of areas north and northeast of the Lodgepole unit and of the Picket Pin Mountain area.

Movement of radio-collared individuals from summering areas toward winter ranges occurred during October and November 1981. It should be noted that three of the six elk marked in 1981 did not spend the 1981-82 winter on winter ranges they occupied during the 1980-81 winter: bull #110 wintered 8 airline km (5 mi) northeast of the Lodgepole unit; cow #205 wintered 12 airline km (7.5 mi) northeast of the Picket Pin unit and cow #207 wintered 7.5 airline km (4.5 mi) northeast of the Lodgepole unit.

Elk movement data gathered during this study indicate that major changes in movement patterns and distribution of the Upper Stillwater elk herd have occurred since previous intensive studies were terminated in 1976. Observed changes in winter-spring distribution may be due to: 1) increased snowmobile activity in the Picket Pin area, 2) increased activity in the Cathedral Mountain subdivision, 3) increased vehicle and helicopter activity associated with mineral exploration or 4) a combination of the above and/or some other factor or factors. The most probable explanation is a combination of increased snowmobile activity, increased activity in the Cathedral Mountain subdivision and increased disturbances from mineral exploration in the vicinity of traditional

winter ranges. Shifts in distribution are such that they allow elk to minimize disturbances from the above sources.

Changes in year-long movement patterns of the Upper Stillwater elk herd since the 1970's may be an artifact of winter distributional changes, although the possibility exists that they reflect disturbances on summer ranges as well. Movements of radio-marked elk during the period of this study indicate that major distributional changes are still occurring (notably movements to Bad Canyon), suggesting that herd distribution and movement patterns are in a state of flux.

Population Characteristics

The elk population of the Upper Stillwater appears to be healthy, exhibiting an upward trend at this time. The minimum total count of 104 in February 1982 is the highest recorded for this herd. Winter counts and classifications recorded during the past 11 years (Simmons et al. 1981) are presented in Table 28.

Hunting recreation provided by this elk herd is considerable in spite of its relatively small size. General hunting on the herd is for antlered bulls-only. In addition, 25 either-sex permits were available in 1981, as was the case in recent years. A total of 342 hunters was in the field in 1980 (Simmons et al. 1981). This was essentially the same number that had hunted the previous year, but was nearly 40% below the 1975-1978 average of 553 hunters annually (Simmons et al. 1981). Harvest on this herd is variable, but generally ranges between 10-20 animals. In 1980, overall success was 1% for general bull hunters who spent an average of 285 days afield for each elk taken. Special permit holders averaged only 20 days afield/elk harvested and had a success rate of 26% (Simmons et al. 1981). It should be noted that these figures do not include time spent hunting by archers. Both numbers of archers and time spent in the field appear to be increasing.

Table 28. Total counts and classification of elk on the Upper Stillwater winter range, 1971-81

Year	Bulls	Cows	Calves	Uncl.	Total	Calves/ 100 Cows	Calves/ 100 Adults	Bulls/ 100 Cows
1970-71	1	29	5	0	35	17	17	3
1971-72	1	29	13	0	43	45	43	3
1972-73	8	27	15	0	50	55	43	30
1973-74	3	19	13	24	62	68	59	16
1974-75	1	36	15	4	56	42	41	3
1975-76	3	40	17	7	67	43	40	7
1976-77	5	44	10	0	59	23	20	11
1977-78	2	51	19	0	72	37	36	4
1978-79	8	29	7	0	44	22	19	28
1979-80	4	53	15	0	72	28	26	8
1980-81	6	58	22	0	86	38	34	10
1981-82	6	75	23	0	104*	31	28	8

*Does not include a radio-marked bull wintering in Blind Bridger Creek and two radio-marked cows (and their calves) wintering in Bad Canyon.

Potential Impacts

Dramatic changes in winter distribution of the Upper Stillwater elk herd since initiation of mineral exploration in the vicinity of traditional winter ranges indicate that impacts to this population have already occurred. Although productivity and general health have remained satisfactory to date, impacts may yet be expressed in this population, which appears to be in a state of flux. Initiation of a full-scale mining operation would be expected to result in far more substantial impacts than those associated with mineral exploration activity.

A by-product of recent changes in winter distribution of the Upper Stillwater elk herd is a shift from areas where elk are not in direct competition with agriculture (Horseman Flats and the Main Stillwater) to areas where this is a problem (Picket Pin and Lodgepole). Conflicts between wintering elk and landowners could eventually result in a need to substantially reduce herd size which in turn would limit recreational opportunities that the herd provides sportsmen and sightseers at its current population level.

Indirect impacts of the proposed mining operation and associated influx of people to the area would include increased hunting pressure and/or poaching as well as increased human recreational activity on elk winter ranges. Hunting pressure could increase to the extent that it would be necessary for MDFWP to implement permit-only hunting regulations to protect the herd from overhunting. Such restrictive hunting regulations would severely limit recreational opportunities presently available to Montana elk hunters and, for all practical purposes, would put outfitters and guides in the Upper Stillwater Valley out of business.

Disturbance of wintering elk by increasing numbers of winter recreationists, particularly snowmobilers, would have a significant detrimental effect on the elk population. It is anticipated that this problem would be most pronounced on the Picket Pin and Lodgepole winter range units.

The Upper Stillwater elk herd provides substantial recreational opportunities

for the people of Montana. Both consumptive use (hunting) and nonconsumptive use (such as viewing and photography) of this herd is currently at high levels and will undoubtedly continue to increase in the future. Every effort should be made to maintain this herd and its habitats for the enjoyment of future generations.

Moose

Moose capture efforts met with limited success. Moose were difficult to locate due to lack of snow cover, exceptionally mild weather and low population densities. Most moose sightings were in locations where darting was precluded, due to heavy cover or inaccessibility with a helicopter. Several moose were successfully darted, but failed to respond to the drug. Drug dosages were kept at the minimum to avoid possible mortality. One adult cow moose was successfully captured and fitted with a radio transmitter collar.

Discussion

A cow moose was captured March 1, 1981 on the Middle Fork of Fishtail Creek. She has remained in the Fishtail-West Fishtail Creek vicinity since that time (Fig. 16) with a year-long home range size of 10 km^2 (3.9 mi^2). Several other moose have been observed near and with this marked cow.

Very little information is available for moose on the study area. Limited data suggest that moose numbers have declined and their range has decreased since the 1950's (Stoneberg 1977). Moose or moose sign are most commonly seen along Fishtail and Fiddler creeks and the Main Stillwater canyon from Woodbine Campground to Flood Creek. A mature bull moose was observed at the Woodbine trailhead in May 1982. Stoneberg stated that Flood Creek, Wounded Man Creek and Horseshoe Creek were areas especially important to moose.

Seasonal concentration areas and migration corridors for moose on the study area can be delineated only through additional efforts to capture moose and monitor movements through the use of biotelemetry.

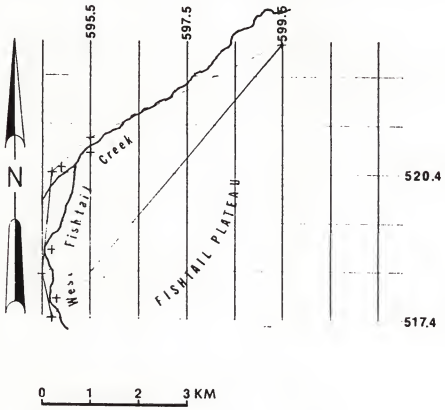

Fig. 16. Year-long range of radio-marked cow moose, Upper Stillwater study area, 1981.

Bighorn Sheep

History

Bighorn sheep *(Ovis canadensis canadensis)* are native to the Stillwater Valley. Historically, bighorns wintered as far upstream as Mosquito and Wildcat mountains (19-24 km (12-15 mi) south of the old Mouat mine site) and as far north as Sheep Mountain (just north of Nye). The present winter range, on and adjacent to the Beartooth Ranch, was probably the core wintering area with peripheral wintering areas primarily occupied only by rams, except during population highs or during mild winters.

Historical population estimates discussed by Stewart (1975) refer primarily to numbers of bighorns using the Beartooth winter range. Typically, counts of this group of sheep have totaled between 25 and 55 since the early 1900's. However, the efficiency of these counts is unknown, making population estimates difficult. The number of animals using peripheral areas is unknown. While the Sheep Mountain winter range was probably abandoned in the early 1900's, some sheep may have wintered in the Upper Stillwater, particularly in the Wildcat Mountain and Tripod Hill areas, until the late 1960's. By 1971 the only remaining bighorn winter range in the Stillwater Valley was the Beartooth Ranch area.

Population Dynamics

Population dynamics of bighorns wintering in the Beartooth Ranch area have been intensively studied since 1971-72. Observations of bighorns on the winter range were obtained almost daily between December and early May, from 1971-72 through 1975-76. Thereafter, through 1981-82, observations were made at approximately weekly intervals. All observations were made from the highway which crosses the winter range. Approximately 20-30% of the ewes in the population and some rams have been marked with individually recognizable neckbands throughout the study.

The annual age structure of adult ewes was calculated with yearling recruitment added as necessary to account for both total numbers of ewes present on

the winter range and known mortality from each previous year. Since additional mortality may have occurred among adult ewes than was detected, the number of yearling ewes probably was underestimated in some years. Lacking specific data we estimated only one yearling ewe in the 1971-72 population, based on the fact that only one yearling ram was present. The effect of this arbitrary decision was canceled by 1974.

Annual counts and classifications of bighorns were highly consistent with each other within and between years. In addition, frequent observation of marked bighorns and our ability to accurately follow several cohorts over an 11-year period indicated that annual population estimates and classifications were extremely accurate, with few if any animals being missed in any census period. Due to the small size and accessibility of the winter range and the behavior of the bighorns, this herd can be accurately censused during the rut in late November, December and early January and again during green-up in late March and April.

Population size increased from 33 bighorns in the winter of 1971-72 to an average of 45 during the next four winters (1972-73 through 1975-76), 50 animals in 1976-77 and 60 in 1977-78 (Table 29). From 51 to 55 sheep have been on the winter range during each of the last four winters. Much of the population increase resulted from a four-fold increase in ram numbers between 1971 and 1981. Ewe numbers increased about 50% between 1971 and 1975, then remained relatively stable. Lamb numbers fluctuated annually, but averaged about 12.

Initial lamb production is unknown. Lambing areas were not located until the summer of 1980. Adequate production data cannot be obtained because these areas are extremely difficult to survey. Thus, lamb production and early survival can only be estimated. A lambing rate of 90 lambs/100 ewes 3 years old and older is assumed to be a reasonable average for most years and was probably exceeded in 1973.

Lamb survival to 6 months of age was in excess of 70% in 6 of the 11 years

Table 29. Size of the Stillwater bighorn population, post-hunting season, 1971-72 to 1981-82

Year	Rams	Ewes	Lambs	Total
1971-72	4	18	11	33
1972-73	8	22	14	44
1973-74	7	25	15	47
1974-75	7	28	11	46
1975-76	7	28	9	44
1976-77	11	27	12	50
1977-78	13	31	16	60
1978-79	12	25	15	52
1979-80	17	26	8	51
1980-81	14	27	11	52
1981-82	18	26	11	55

Table 30. Potential lamb production based on a birth rate of 90 lambs/100 ewes 3 years old and older and survival of lambs for the Stillwater bighorn population, 1971-72 through 1981-82

Year	3-Year Olds & Older Ewes	Potential Lambs	Lambs Alice at 6 Months	Percent Survival	Lambs Alive at 1 Year	Percent Survival from Birth
1971-72	17	15	11	73	11	73
1972-73	17	15	14	93	14	93
1973-74	16	14	15	100	9	64
1974-75	16	14	11	79	9	64
1975-76	21	19	9	47	9	47
1976-77	24	22	12	55	12	55
1977-78	25	22	16	73	15	68
1978-79	23	21	15	71	14	67
1979-80	23	21	8	38	4	19
1980-81	23	21	11	52	11	52
1981-82	21	19	11	58	11	58

Table 31. Number of yearlings, 2 and 3-year-old and older ewes in the Stillwater population during winter, 1971-72 and 1981-82

Year	Yearlings	2 Years	3+ Years
1971-72	1	?	17
1972-73	4	1	17
1973-74	7	4	14
1974-75	6	6	16
1975-76	1	6	21
1976-77	2	1	24
1977-78	4	2	25
1978-79	1	2	22
1979-80	2	1	23
1980-81	3	1	23
1981-82	2	3	21

and averaged 67% for all 11 years (Table 30). Survival was sharply lower in both 1976 and 1980 - years following severe winters. Survival was also lower in 1977 and 1981, following moderate or mild winters. It appears that severe winter weather can affect lamb production and survival in this bighorn herd for the following 2 years. Lamb survival was also low in 1982. Lower survival rates that year could not be related to weather. Lamb survival for the first year of life has averaged 59%. Overwinter lamb mortality has averaged 11%.

Age composition of the ewe segment of the population is shown in Table 31. An average of three yearling ewes was recruited into the population annually. However, yearlings incurred the highest annual mortality among adult ewes, averaging 41% since 1972 (Table 32). Relatively low mortality was characteristic of ewes 2 to 4 years of age, averaging only 11%. Higher mortality, averaging 26%, prevailed between 5 and 10 years of age, with few ewes surviving past 10 years. The oldest ewe in the population was 15 years old in June 1982.

Table 32. Average annual natural mortality of Stillwater ewes by age class, 1971-72 to 1981-82

	Age Classes														
	Lambs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of ewes entering age class	92[1]	54	29	9	9	10	7	10	6	3	3	1	1	1	1
No. of ewes entering next age class	54	32	26	8	8	8	6	8	4	2	2	1	1	1	1
Percent mortality	41	41	10	11	11	20	14	20	33	33	33	0	0	0	0

[1]Number of ewe lambs projected to be born 1971-81, based on ratio of 90 lambs/100 3+-year-old ewes and a 50:50 lamb sex ratio.

Mortality rates and patterns among rams in the Stillwater population have been greatly influenced by changes in hunting regulations since 1975. In 1975 the Stillwater winter range was closed to hunting and a quota was set on the

Table 33. Post-hunting season age distribution of Stillwater ram population, 1971-72 through 1981-82

Year	Yearling		Two		Three		Four		Five		Six		Seven		Eight		Nine
1971-72	1	I[1]	3	2H[2]	0		0		0		0		0		0		0
1972-73	5	W & S[3]	2	W & I	1	H	0		0		0		0		0		0
1973-74	2		3	2H	2	H	0		0		0		0		0		0
1974-75	3	S	2		1		1	H	0		0		0		0		0
1975-76	2	S	2	H	2		1		0		0		0		0		0
1976-77	6	2S	1		1		2	S[4]	1		0		0		0		0
1977-78	5	3S	4	H	1		1		1		1		0		0		0
1978-79	3		2		3		1		1		1		1		0		0
1979-80	6	S	3	S[4]	2	H	3		1		1		1		0		0
1980-81	1		4	S	2		1		3		1		1		1		0
1981-82	5		1		3		2		1		3		1		1		1

[1] I = immigration.

[2] H = hunting mortality.

[3] W = known winter mortality, S = summer mortality of emigration.

[4] These were known mortalities.

number of rams that could be harvested from the population. These regulations resulted in a decline in harvest and a corresponding increase in the number of rams over 4 years old (Table 33).

Under the unlimited three-quarter-curl harvest in effect through 1974, most rams were being harvested when they reached three-quarter curl as 3-year olds and all were killed before they reached 5 years of age (Table 33). Because of this, the data primarily represent natural mortality to 3 years of age. Only after 1975 when ram survival increased, were data for older animals obtained.

Among ten cohorts followed between their second and third winters, numbers declined in six, remained the same in three and increased in one (Table 22). This indicated either a significant mortality or emigration during the third summer. In either case a substantial net loss of rams from the population occurred, which can only be treated as mortality in terms of general population dynamics.

Calculated average annual natural mortality rates indicate that from the time a ram cohort is born until it is 3 years old, it is subjected to average annual mortality of about 36% (Table 34). Between 3 and 7 years of age, natural mortality averaged only 5% annually. To date, only three rams have lived past their eighth birthday.

Table 34. Average annual natural mortality of Stillwater rams by age class, 1971-72 to 1981-82

	Age Classes									
	Lambs	1	2	3	4	5	6	7	8	9
No. of rams entering age class	92[1]	54	33	19	13	9	7	4	3	1
No. of rams entering next age class	54	34	23	17	13	7	7	4	2	1
Percent mortality	41	37	30	11	0	22	0	0	33	0

[1]Number of ram lambs projected to be born 1971-1981, based on ratio of 90 lambs/100 3+-year-old ewes and a 50:50 lamb sex ratio.

At present the size of the Stillwater bighorn population is primarily controlled by a high rate of mortality or emigration of yearlings of both sexes and of 2-year-old rams. Stoneberg (1977) suggested that sheep numbers were not being limited by the available food supply. Rather, the herd may be responding to density dependent factors resulting from the small size of the winter range, independent of winter range forage conditions. The hypothesis was compatible with population data through the late 1970's. However, more recent data suggest that new bighorn distribution patterns have resulted in forage deficiencies. This will be further discussed later.

The rate of inbreeding in the Stillwater bighorn herd appears to be very high due to several factors: 1) the population is isolated for all practical purposes, 2) the population has been and continues to be small and 3) hunting practices in the late 1960's and early 1970's severely reduced the number of effective males. The rate of inbreeding for this population has been calculated to be in excess of 30% (Dr. R. G. Peterson, University of British Columbia, pers. comm.).

Such a high rate of inbreeding results in a relatively homozygous population. As such, the population is adapted to a fairly narrow set of environmental conditions and lacks the genetic diversity to respond readily to changes in its environment. Thus, as long as the status quo is maintained, the bighorn population will survive provided that inbreeding levels have not reached the point where lamb production and survival are impaired. This does not appear to be the case in the Stillwater, since lamb production and survival until recently compared favorably with that of other populations (Stewart 1980).

However, because of its homozygous nature, an inbred bighorn population cannot be expected to tolerate stress. It can be predicted that severe stress in such a herd will result in a deterioration of animal condition, increased mortality rates, decreased reproductive rates and ultimately severe population declines and possibly extinction.

Perpetuation of the Stillwater bighorn sheep population will depend on our ability to minimize stress and maintain existing environmental conditions until the genetic health of the population can be restored through the introduction of unrelated sheep.

Distribution and Movements

The major winter concentration area for bighorn sheep (Fig. 17) lies between the old Mouat mine site to the north and the Woodbine trailhead to the south, along the west side of the Stillwater River. This primary concentration area covers slightly less than 8 km^2 (3 mi^2). All of the Stillwater bighorns use this area at some time during the winter. A peripheral winter range occurs on the east side of the Stillwater River between the old Mouat mine site and the northeast end of the John Mouat property, 4 km (2.5 mi) to the north. The actual area occupied by bighorns on this peripheral winter range is about 2 km^2 (.8 mi^2). Fewer than ten bighorns use this area at various times during the winter. Another peripheral winter range occurs on the southeast slope in the Sioux Charley Lake area, approximately 4 km (2.5 mi) southwest of the Woodbine trailhead. Data are lacking as to the size of this area and number of animals using it.

Most bighorns begin returning to the winter range by mid-October each year and stay until late May or early June (8-9 months). All rut activity takes place on the primary winter range. The rocky reefs south of the old Mouat mine site and south of the Woodbine trailhead and the Stillwater Canyon north of Verdigris Creek are the most important areas during the rut. Following the rut, mature rams segregate themselves from the rest of the herd. Mature rams restrict themselves primarily to the mine roads in the Verdigris Creek area after approximately January 15. Only in late March and early April when grass begins to green-up on lower slopes, do the rams move down as low as the upper reaches of the ewes' winter range. This overlap in winter ranges lasts approximately 3

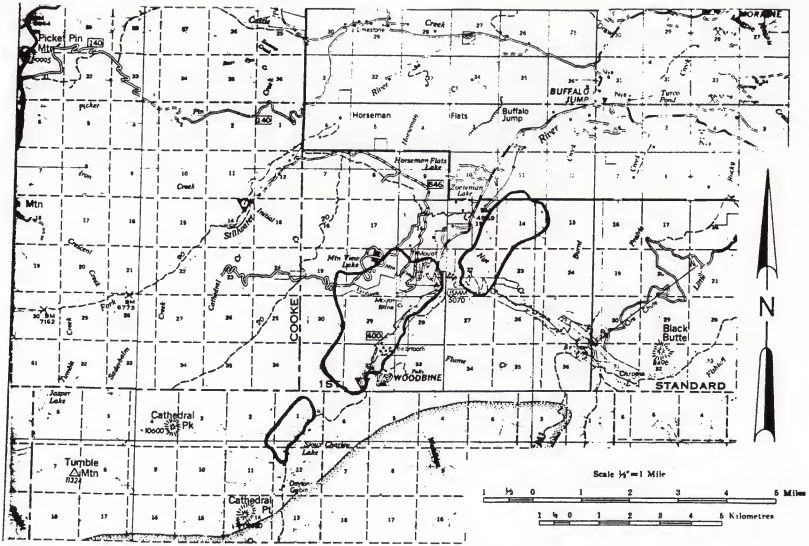

Fig. 17. Bighorn sheep winter range, Upper Stillwater study area.

weeks until the rams return to the mine roads. Peripheral winter ranges appear to be occupied primarily by ewes, lambs and immature rams and only occasionally by adult rams.

About June 1 ewes begin leaving the winter range and moving to lambing areas. Exact locations of these lambing areas have not been documented. However, it appears that many ewes move up the Stillwater and into the Flood Creek drainage for lambing, concentrating in the first drainage that comes into Flood Creek from the south. This drainage is apparently also used as a nursery area. No evidence has been found to suggest that lambing occurs on any portion of the winter range. It is possible that some ewes lamb in the vicinity of Cathedral Point. Barren ewes remain on the winter range until about June 15.

Summer ranges for ewes and rams are distinctly different. Ewes remain in the Flood Creek drainage throughout much of the summer. During this season they make use of most of the alpine basins in the vicinity of Two Sisters. They also use all of the drainages that run into Flood Creek from the north - particularly Rabbit Gulch and the basins near Tumble Mountain. Ewes periodically return to the winter range during the summer and spend a substantial amount of time on the old mine roads. Little use is made of the portions of the winter range lying at lower elevations.

Rams begin moving to their summer ranges between June 1 and June 15. Like the ewes, most rams move up the Stillwater River to Flood Creek, though a few may travel as far as Wounded Man Creek. They migrate west from these drainages, cross the Lake Plateau and move onto the eastern edge of their summer range in the Columbine Lake area. From there, rams eventually move across the East Fork of the Boulder River to Monument, Haystack and Sheepherder peaks. A few rams migrate even farther west - as far as Middle Ridge in the Hellroaring Creek drainage. At this point they have traveled in excess of 65 km (50 airline km or 31 airline mi) from the winter range. A few rams also move into the Rainbow Lakes area for part of the summer. Rams remain on summer ranges until mid to

late September when they move back into the Flood Creek and Wounded Man drainages.

During early fall (September 15-October 15) ewes remain in summering areas. Rams occupy the same areas, though they continue to isolate themselves from the ewes. As snowstorms become more frequent at high elevations, all sheep begin to drift into the Stillwater drainage and onto the winter range. Some sheep, mostly ewes and young rams, are back on the winter range to stay by October 15. Typically, all of the bighorns are on the winter range by late November. Year-long herd range for the Stillwater bighorns is illustrated in Fig. 18.

There was a total of 14 marked bighorns (10 ewes and 4 rams) on the Stillwater winter range during 1980-81 (Appendix Table 44). Twelve of these sheep were still present during 1981-82 (ewes #01 and #34 were unaccounted for and presumed dead in 1981-82). During the 1981-82 winter, seven of the marked bighorns (five ewes and two rams) carried functional radio transmitter collars. All but two of these had ceased functioning by 1981-82. Relocations of marked animals were used to calculate seasonal home range sizes. A summary of seasonal movements follows:

During the 1980-81 winter (December 1-April 21), ewe home ranges (Table 35) varied in size from 0.3 km^2 to 7.2 km^2 (.1 mi^2 to 2.8^2) and averaged 2.6 km^2 (1 mi^2). The cumulative home range of all marked ewes was 24.5 km^2 (9.5 mi^2) (Fig. 19). The following winter ewe home ranges varied in size from 0.39 km^2 to 1.50 km^2 (.15 mi^2 to .58 mi^2) averaging 1.01 km^2 (0.39 mi^2). The cumulative home range of all marked ewes was 3.33 km^2 (1.29 mi^2) (Fig. 20). Three factors contributed to the decline in ewe home range sizes in 1981-82: 1) the somewhat more severe winter resulted in more restricted movements of ewes, 2) the loss of radio collars made it impossible to locate ewes when they traveled beyond the limits of the portions of the winter range that could generally be surveyed and 3) ewe #34, who spent much of the 1980-81 winter traveling from the Beartooth Ranch to Sioux Charley Lake and thereby substantially increasing the average and cumulative home range sizes, died prior to the winter of 1981-82.

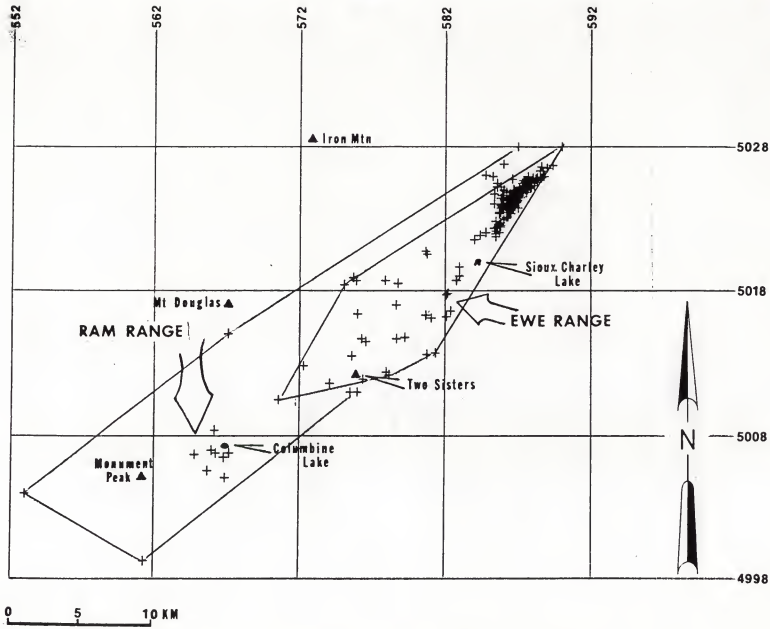

Fig. 18. Year-long distribution of marked rams and ewes, Upper Stillwater study area, 1980-82.

Table 35. Winter (December 1, 1980-April 21, 1981 and December 1, 1981-April 15, 1982) home range sizes and centers of activity for marked bighorn ewes on the Stillwater winter range

Ewe Number	Year	Home Range Size (km^2/mi^2)	Center of Activity (UTM)	Number of Relocations
01	1980-81 1981-82	.53/.20 -	5866-50240 -	7 -
02	1980-81 1981-82	1.67/.65 1.50/.58	5866-50241 5870-50245	21 17
10	1980-81 1981-82	1.33/.51 1.24/.48	5866-50242 5870-50246	17 12
17	1980-81 1981-82	1.10/.42 .75/.29	5864-50240 5869-50244	13 11
21	1980-81 1981-82	1.07/.41 1.34/.52	5869-50245 5870-50246	8 20
24	1980-81 1981-82	7.17/2.77 .39/.15	5866-50249 5868-50244	13 5
25	1980-81 1981-82	1.82/.70 .84/.32	5865-50241 5867-50242	14 15
34	1980-81 1981-82	7.10/2.74 -	5866-50242 -	17 -
59	1980-81 1981-82	.34/.13 .76/.30	5874-50251 5870-50247	9 12
66	1980-81 1981-82	4.03/1.56 1.28/.50	5865-50239 5868-50244	24 18
All Ewes	1980-81 1981-82	24.54/9.47* 3.33/1.29	5866-50242 5869-50245	153 110

*Cumulative home range denoted area encompassed by line connecting outermost relocations for all home ranges. May be greater or less than the sume of the areas for individual home ranges as determined by their degree of overlap.

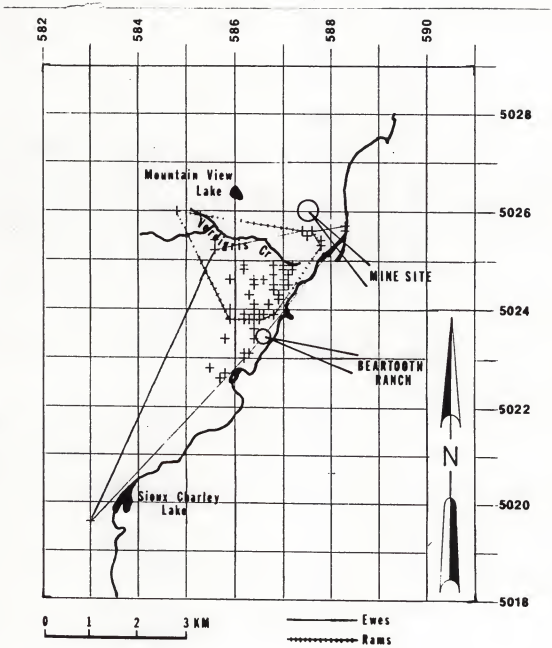

Fig. 19. Winter 1980-81 relocations of marked bighorn sheep, Upper Stillwater study area.

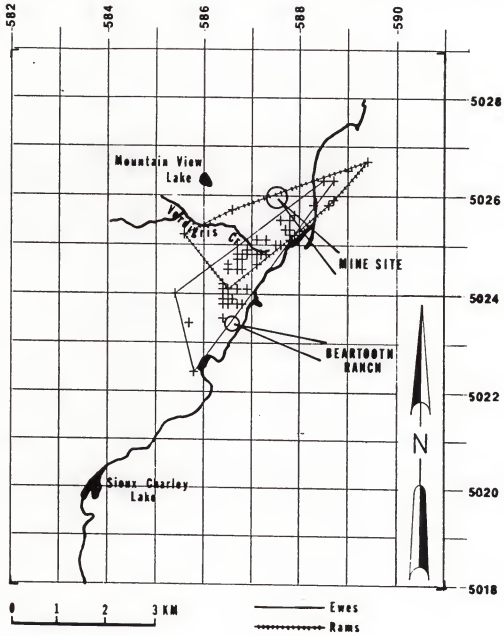

Fig. 20. Winter 1981-82 relocations of marked bighorn sheep, Upper Stillwater study area.

Ram winter range sizes during 1980-81 (Table 36) varied from 0.4 km^2 to 2.6 km^2 (.15 mi^2 to 1 mi^2) and averaged 1.5 km^2 (.6 mi^2). The cumulative home range for all marked rams was 3.9 km^2 (1.5 mi^2). In 1981-82 ram winter range sizes varied from .4 to 1.94 km^2 (.15 to .75 mi^2) and averaged 0.97 km^2 (.37 mi^2). The cumulative home range for all rams was 3.27 km^2 (1.26 mi^2). As with the ewes the smaller ram home range sizes in 1981-82 was probably due to 1) more severe winter weather and 2) fewer functioning radios, making relocations more difficult.

Table 36. Winter (December 1; 1980-April 21, 1981 and December 1, 1981-April 15, 1982) home range sizes and centers of activity for marked bighorn rams on the Stillwater winter range

Ram Number	Year	Home Range Sizes (km^2/mi^2)	Center of Activity	Number of Relocations
16	1980-81	.39/.15	5863-50241	5
	1981-82	.74/.28	5870-50249	5
27	1980-81	2.56/.99	5867-50249	8
	1981-82	.40/.15	5872-50251	3
33	1980-81	1.58/.61	5865-50247	7
	1981-82	1.94/.75	5878-50257	9
69	1980-81	1.50/.58	5859-50246	7
	1981-82	.79/.30	5879-50254	6
All Rams	1980-81	3.90/1.51*	5864-50246	27
	1981-82	3.27/1.26	5876-50254	23

*Cumulative home range denotes area encompassed by line connecting outermost reclocations for all home ranges. May be greater or less than the sum of the areas for individual home ranges as determined by their degree of overlap.

Four of the collared ewes had been marked for several years previous to this study, making it possible to compare previous years' home range sizes to those obtained for the 1980-81 and 1981-82 winters (Table 37). Three of the four ewes had small winter home ranges (0.3-0.7 km^2) (.01-.3 mi^2) from 1976-77

Table 37. Home range sizes for four Stillwater bighorn ewes during winter, 1976-77 through 1981-82

Ewes		1976-77 (Mild)[1]	1977-78 (Moderate)	1978-79 (Severe)	1979-80 (Mild)	1980-81 (Mild)	1981-82 (Moderate)
#01	Home range size (km^2/mi^2)	.05/.02	.73/.28	.42/.16	1.66/.64	.53/.21	-
	Sample size	4	8	15	14	7	-
#02	Home range size (km^2/mi^2)	-	.03/.01	.44/.17	2.30/.89	1.67.65	1.50/.58
	Sample size	-	5	16	16	21	17
#59	Home range size (km^2/mi^2)	.82/.32	.49/.19	2.34/.91	.66/.26	.34/.13	.76/.30
	Sample size	9	8	14	15	9	12
#66	Home range size (km^2/mi^2)	.52/.20	.29/.11	.42/.16	2.83/1.10	4.03/1.57	1.28/.50
	Sample size	8	8	16	14	24	18

[1]General winter weather conditions.

through 1978-79 despite extreme differences in winter severity. During the 1979-80 winter, their home range sizes increased two to five times. Winter range sizes remained large in both 1980-81 and 1981-82 for two of the three ewes (an injury that ultimately resulted in the death of ewe #01 prevented her from moving over a large area in 1980-81). The fourth ewe (#59) has maintained a relatively small home range throughout the 1977 to 1982 period with the exception of 1978-79 when her home range was quite large.

Thus, with the exception of ewe #59, ewe winter range sizes increased substantially in 1979-80, the same year that there were substantial increases in human activity on and near the winter range in conjunction with the Minneapolis adit. Mining activities continued through 1981-82 and ewe home ranges remained large. These data suggest that the human activity associated with the present mining venture has resulted in significant disturbance of sheep that normally occupy the less secure portions of the winter range on and adjacent to the Beartooth Ranch. This hypothesis is supported by the movements of ewe #59. Her winter home range has remained relatively small throughout this period of disturbance because she spends most of her time in the rocky area between Vergigris Creek and the Anaconda Company administration building, were security is excellent. (Note the difference in centers of activity between ewe #59 and all other ewes) (Table 35). Therefore, she has remainted relatively immune to the human activities that have affected the other bighorns and has not been forced to become more mobile as others have.

Spring (April 22-June 2) home range sizes could only be determined for five marked ewes in 1981. These seasonal home ranges varied from 0.3 km^2 to 7.0 km^2 (.1 mi^2 to 2.7 mi^2) and averaged 3.4 km^2 (1.3 mi^2) (Table 38). The spring home ranges include at least part of the migration route for all ewes except #66 whose transmitter failed prior to her leaving the winter range. The cumulative spring home range size for all ewes was 11.3 km^2 (4.4 mi^2). Ram spring home ranges varied in size from 0.1 km^2 to 2.6 km^2 (.03 mi^2 to 1 mi^2) and averaged

1.2 km^2 (.5 mi^2). Cumulative spring home range size for all rams was 4.6 km^2 (1.8 mi^2). The cumulative spring home range for all marked bighorns was 20.3 km^2 (7.9 mi^2). No comparable spring range data are available for the spring of 1982 due to an inadequate number of functioning radio collars.

Table 38. Spring (April 22-June 2) home range sizes and centers of activity for marked bighorn sheep from the Stillwater winter range, 1981

Sex	Animal ID	Home Range Size (km^2/mi^2)	Center of Activity (UTM)	Number of Relocations
Ewe	21	5.47/2.11	5855-50227	6
Ewe	24	7.02/2.71	5860-50236	5
Ewe	25	2.95/1.14	5858-50231	6
Ewe	34	1.26/.49	5861-50234	5
Ewe	66	.32/.13	5867-50244	6
All ewes		11.32/4.37*	5860-50234	28
Ram	27	.07/.03	5861-50244	3
Ram	33	.88/.34	5860-50250	5
Ram	69	2.60/1.0	5853-50245	5
All rams		4.62/1.78*	5858-50247	13

*Cumulative home range denotes area encompassed by line connecting outermost relocations for all home ranges. May be greater or less than the sum of the areas for individual home ranges as determined by their degree of overlap.

Summer (June 3-Sept. 15) home ranges for rams varied from 3.5 km^2 to 56.1 km^2 (1.3 mi^2 to 21.6 mi^2) and averaged 22.4 km^2 (8.7 mi^2) in 1981 (Table 39). As would be expected, bighorns appear to be most mobile during this period. The only ewe transmitter that continued to function throughout the summer was worn by ewe #25. Her summer home range was 50.3 km^2 (19.4 mi^2), illustrating the great mobility of bighorns during summer. The cumulative home range for

all marked bighorns during summer was 250.8 km^2 (96.8 mi^2). No comparable summer range data are available for the summer of 1982, due to an inadequate number of functioning radio collars.

Table 39. Summer (June 3-September 15) home range sizes and centers of activity for marked bighorn sheep from the Stillwater winter range, 1981

Sex	Animal ID	Home Range Size (km^2/mi^2)	Center of Activity (UTM)	Number of Relocations
Ram	27	3.47/1.34	5666-50095	3
Ram	33	56.06/21.64	5695-50101	9
Ram	69	7.70/2.97	5611-50054	3
All rams		109.63/42.32*	5666-50090	15

*Cumulative home range denotes area encompassed by line connecting outermost relocations for all home ranges. May be greater or less than the sum of the areas for individual home ranges as determined by their degree of overlap.

During 1981 the fall (September 15-November 30) home range size for ewe #25 was 125.7 km^2 (48.9 mi^2). For ram #33 the fall home range size was 14.9 km^2 (5.8 mi^2). The cumulative fall home range sizes for all marked rams, all marked ewes and all marked sheep were 25.7 km^2, 208.4 km^2 and 385.8 km^2 (10.0 mi^2, 81.1 mi^2 and 150.0 mi^2), respectively. During this period all bighorns migrated from summer ranges to the winter range.

Habitat Use

Typically, studies of habitat use yield biased results because data can be recorded only for those animals that are observed. Animals using habitats or areas where observation is not possible are ignored, resulting in the appearance that these habitats are not important.

In analyzing habitat use information for the Stillwater bighorn sheep herd, an attempt was made to overcome this bias. During each survey bighorns were recorded as to the habitat type in which they were observed. The total number

of bighorns observed during the survey was then substracted from the known bighorn population, yielding the number of sheep that were located in habitats where observation was not possible. While this approach does not identify the habitat types that bighorns use without being seen, it does more adequately reflect the relative importance of types were observation is possible.

During the winter of 1974-75, 50% of all bighorn use was in the Feid/Agsp and Rhtr/Agsp habitat types (Table 40). Only 27% of the use that winter occurred in habitats where observation was not possible. By 1980-81 this pattern had changed drastically. Only 27% of the bighorn use occurred in the Feid/Agsp and Rhtr/Agsp habitat types. At the same time, use of habitats where bighorns could not be observed jumped to 61%. This new pattern of use intensified during the winter of 1981-82 when only 17% of the bighorn use was in the Feid/Agsp and Rhtr/Agsp habitat types and 72% was in habitats where bighorns could not be observed.

Table 40. Comparative habitat use by Stillwater bighorn sheep during winters, 1974-75 and 1980-81

Years		Feid/ Agsp	Rhtr/ Agsp	Artr/ Agsp	Psme/ Agsp	Psme/ Feid	Rock	Misc.[1]	Other[2]
1974-75	N	1,470	735	352	160	32	448	-	1,165
	%	33	17	8	4	1	10	-	27
1980-81	N	316	123	29	35	37	73	10	989
	%	19	8	2	2	2	5	1	61
1981-82	N	181	158	6	86	8	38	84	1,474
	%	9	8	tr[3]	4	tr	2	4	72

[1] Includes river bottom and reclamation areas.

[2] Habitat types where observations were not possible (see text).

[3] tr = trace (<1%).

Stewart (1975) determined that the highest quality forage available to the Stillwater bighorns was in the Feid/Agsp habitat type. This was the preferred type for bighorns with 46% of all use occurring there. By 1981-82 use of the

Feid/Agsp habitat type had declined to only 9%. This represents a decline in use of 80%.

It appears that the same disturbance factors which caused the tremendous increase in bighorn home range size during the 1979-80 through 1981-82 winters have also forced the bighorns to abandon their preferred foraging areas in favor of areas with high security values.

Hunting

Rams from the Stillwater herd have been hunted since 1953. This is one of the very few areas in the United States where an unlimited number of permits are available to hunters. Such liberal seasons are possible because 1) the fall range of rams is extremely rugged making rams nearly impossible to find, 2) harvest is tightly controlled by a quota system (the season is closed when the desired harvest is reached) and 3) hunters are limited to taking only mature rams under the three-fourths-curl law. In addition, hunting is not allowed on any portion of the winter range, to eliminate any possible stress on the ewe segment of the herd.

Because of the liberal season and fact that the bighorn is one of the world's most desired trophies, hunters come to this area from all over the United States as well as from throughout Montana. Between 1975 and 1980, 334 bighorn permits were sold to hunters (Table 41). A total of 224 hunters actually hunted bighorns during that period and 12 were successful. Obviously, the success rate is not high, but the important fact is that many sportsmen have had the opportunity to hunt bighorn sheep.

Discussion and Summary

The previous sections of this report have documented several important points concerning the Stillwater bighorn population. First, lamb production and/or survival is declining. Second, winter home range sizes, particularly of adult ewes, have increased substantially since Anaconda Company's exploration activities were initiated in 1979-80. Third, use of preferred foraging areas

by bighorns has declined dramatically, while use of high security areas has correspondingly increased. Understanding the relationship of these factors is important to the understanding of the potential impacts of a full-scale mining operation.

Table 41. Hunting district 500 bighorn sheep harvest and hunter statistics, 1975-80

Year	Permits Issued	Hunters Hunting	Total Harvest	Percent Success	Hunter Days Afield
1975	84	66	3	5	396
1976	54	37	2	5	296
1977	31	22	1	4	154
1978	34	19	0	0	-
1979	53	45	2	4	228
1980	78	35	4	11	176

During the mid-1970's human activity on and adjacent to the Stillwater bighorn winter range was limited. Vehicle travel on the highway that bisects the winter range was light. On week days this traffic was generally limited to the owners of the Beartooth Ranch and MDFWP personnel. Moderate increases in traffic occurred on weekends. During this period most of the bighorns foraged in the Feid/Agsp habitat type (where the most nutritious forage was available) adjacent to the highway on a daily basis.

This pattern of use changed in 1979-80, the year when exploration activities began at the old Mouat mine site. During that winter vehicle traffic across the bighorn winter range increased substantially. Increased traffic volume occurred on week days as well as weekends. Whether or not this traffic was mine-related could not be determined. In general, however, it was apparent that an increased number of people inhabiting the Upper Stillwater Valley prompted increased vehicle traffic on the winter range. This trend continued through

the 1981-82 winter.

The bighorn sheep population responded to this increased volume of traffic. They began avoiding their preferred foraging areas (Feid/Agsp habitat type) immediately adjacent to the highway. As previously discussed, bighorn use of this segment of the winter range declined by 80% between 1974-75 and 1981-82. Bighorns also began spending more time in high security areas where they could not be observed as easily. Use of these habitats doubled between 1974-75 and 1981-82 with nearly 75% of all bighorn activity occurring in high security areas by the latter winter.

Bighorns also apparently responded to increased activity on their winter range by increasing their movement and thereby increasing their winter home range sizes. Winter home range sizes for some ewes have increased 200 to 500% since mineral exploration was initiated.

A major component of bighorn winter survival strategy is a reduction in energy expenditure. Unfortunately the Stillwater bighorns have been forced to abandon that strategy. Increased movements can only occur with increased energy expenditures. To make matters worse, this increased energy expenditure is occurring at the same time that bighorns are being forced to use forage of lower quality, thus lower energy intake.

This situation must ultimately affect lamb production and survival, possibly even survival of adults. The winter of 1980-81 was one of the mildest on record. Typically such a winter should result in high lamb production and survival. This did not occur. Lamb production and survival to December 1981 was similar to what would be expected after a moderately severe winter. Apparently forage intake during 1980-81 was adequate to sustain most of the adult bighorns, but not adequate to allow for lamb production to achieve expected levels. It can be predicted that during a more "normal" winter adult mortality will increase and the following year's lamb crop will be poor.

As previously discussed, the bighorn population has been stable for the

last 6 years (adult mortality has been offset by lamb production). At this time lamb production and survival are declining. It is predicted that adult mortality will increase or at best remain static. The net result must be a decline in the bighorn population. The extent and rate of the decline cannot be predicted, as it will be determined to a large degree by winter weather. If all disturbance factors continue at the present level and a series of severe winters is encountered, the impacts to the Stillwater bighorn herd could be disastrous.

Potential Impacts

Mining activities on and adjacent to the Stillwater bighorn winter range have and will continue to affect bighorns, both directly and indirectly. Direct effects include loss of winter-spring range by: 1) physical destruction of habitat and 2) mine related activity rendering an area unsuitable for bighorn occupation. Indirect effects are the result of increased numbers of people in the Stillwater Valley. These include increased hunting pressure, increased poaching activities and especially increased human activities on the winter range for recreational purposes, such as sight-seeing.

The direct effects of mining will probably have minimal impact on bighorns if mining activity is restricted to the old Mouat mine site. The old mill site was rarely used by bighorns prior to reclamation in 1979. Bighorns responded to the reclamation almost immediately, probably to the benefit of the population. However, during 1979-80 and 1980-81, large ore samples were dumped on portions of the reclamation area rendering these areas unusable for bighorns. More importantly, high levels of human activity on the old mill site combined with its distance to adequate escape cover negated the beneficial effects of reclamation. The area was essentially unused throughout the 1980-81 and 1981-82 winters. Thus, while the reclamation on the old mill site could have been beneficial to bighorns, its unavailability due to high levels of human use will not be a blow to the sheep since it merely returns the winter range to pre-1979 conditions.

Some of the indirect impacts will probably have a significant negative impact on the bighorns. The result of increased human activity on and adjacent to the winter range during the exploration phase of Anaconda's mine have already been discussed. During the construction phase, human activity in the Upper Stillwater will increase substantially over what it was during the exploration phase. Though the total human population will decline after completion of the construction phase, there will be a substantial net increase in the number of people in the Stillwater Valley as a result of the mining operation. Unless steps are taken to control human activity on the bighorn winter range, disturbances that have been documented during the exploration phase will not only continue but will be magnified as the human population of the vicinity increases. The bighorn herd will decline - as it did during the mining operation conducted on the Mouat property between 1952 and 1961 (Stoneberg 1977). If this decline occurs over a long enough period of time, herd extinction is possible.

Increased numbers of people in the Stillwater will undoubtedly result in increased poaching activities. Any increased adult mortality, particularly of adult ewes, will serve to accelerate the decline in bighorn numbers. Poaching of rams could eventually result in a reduction in the number of effective breeding rams in the population and thereby increase the rate of inbreeding. As the population becomes smaller the likelihood of increased inbreeding rates will accelerate. This will ultimately depress reproduction and lamb survival which in turn will accelerate the population decline. It cannot be overemphasized that adult mortality, particularly that of adult ewes, must be minimized.

Black Bears

Population Density

Black bear observations were made incidental to other field activities in the Upper Stillwater Valley during the spring and early summer of 1981. A total of seven individual bears was known to be utilizing the southeast-facing slopes between the Stratton Ranch and the Beartooth Ranch during May and June 1981

(Table 42). These slopes comprise an area of approximately 10 km^2 (3.9 mi^2) yielding a density of one bear/1.4 km^2 (.5 mi^2). This density represents a spring concentration area and does not necessarily reflect bear densities on a year-long basis. However, it is emphasized that this is a minimum density estimate, since certainly not all bears using the area were observed. This does suggest that the area immediately surrounding the mine site is relatively important spring black bear habitat.

Table 42. Spring 1981 black bear observations in vicinity of Minneapolis adit

Date	Adults	Cubs	Yearlings	Total	Location	Remarks
	1 (black)		2 (black)	3	Stratton Ranch T5S, R15E, Sec. 15	
	1 (black)			1	Beartooth T5S, R15E, Sec. 29	
Mid-June	1 (brown)	1 (black)		2	Beartooth T5S, R15E, Sec. 29	CDM report
Mid-June	1 (brown)			1	Beartooth T5S, R15E, Sec. 29	CDM report

An additional 13 individual bears were located in the Castle, Meyers and Lodgepole creeks area in spring 1981. A total of 10 bears was observed in a 7.8 km^2 (3 mi^2) area of Lodgepole Creek, yielding a spring range density of one bear/.8 km^2 (.3 mi^2). The MDFWP is presently conducting a black bear study in the East Boulder-Dry Fork vicinity, immediately east of the Lodgepole-Meyers Creek area. Spring bear densities of one bear/.9 km^2 (.3 mi^2) in the East Boulder and Dry Fork compare favorably with those found in Lodgepole Creek (Simmons et al. 1981). While no attempt was made to survey bears between Horseman Flats and Castle Creek, it seems likely that similar bear densities occurred in that area. Thus, it appears that a substantial black bear population exists in a fairly large geographical area north and northwest of the mine site. Observed spring range densities varying from 0.8 to 1.5 bear/km^2 (2.1 to 3.8

bear/mi^2) are among the highest densities noted in bear literature (Simmons et al. 1981).

Potential Impacts

Whether or not bears will be directly affected by the mine is unknown, since, nothing is known about bear habitat requirements in the Upper Stillwater. However, an increased human population in the vicinity of the Upper Stillwater Valley would undoubtedly affect bears through increased hunter numbers. This would result in increased legal and illegal harvest. When bear harvest reaches a point where the average age of harvested animals is significantly reduced, hunter pressure must also be reduced. Seasons would be shortened and possibly the spring season would be closed to accomplish this goal. Such actions would substantially reduce hunter opportunity in south central Montana. In 1980, 60% of all bear harvest in MDFWP Region 5 (Billings) came from the relatively small area between the Stillwater and Boulder rivers (hunting districts 520, 560, 562 and 572). Slightly over 40% of this harvest was undoubtedly taken within 10 miles of the mine site (hunting districts 520 and 572).

APPENDIX

Table 43. Capture locations and collar descriptions for radio-collared mule deer, Upper Stillwater study area, 1981-82

Capture Site	Date	Sex	Age	Animal ID (Band/Channel)	Collar Description	
Beartooth	1/11/81	♀	8+	309	Blue/yellow/red	(PVC)
	1/13/81	♀	3½	308	White/red	(PVC)
	2/23/81	♀	6½	109	Solid yellow	(PVC)
Keogh	1/11/81	♀	3½	210	White/red	(PVC)
	1/11/81	♀	7½	212	White/black	(PVC)
	1/11/81	♂	2½	101	Yellow/black	(PVC)
	1/11/81	♂	1½	102	Solid green	(PVC)
	3/16/82	♀	5½	202	White/lt. blue	(PVC)
Robinson Draw	3/16/82	♀	4½	107	Solid green	(PVC)
	3/16/82	♂	1½	206	White/black	(Belting)
	3/16/82	♀	4½	302	Dk. blue/yellow	(PVC)
	3/16/82	♀	3½	304	Red/yellow	(PVC)
	3/16/82	♂	3½	307	Solid white	(Belting)
Hertzler	1/13/81	♂	1½	307	Solid white	(PVC)
	1/13/81	♀	1½	209	Red/white	(PVC)
Magpie	1/12/81	♂	1½	305	White/blue	(PVC)
	1/11/81	♀	4½	403	Solid red	(PVC)

Table 43. Capture locations and collar descriptions for radio-collared mule deer, Upper Stillwater study area, 1981-82 (cont.)

Capture Site	Date	Sex	Age	Animal ID (Band/Channel)	Collar Description	
Magpie	3/17/82	♀	3½	404	Lt. blue/yellow	(PVC)
Dean	1/13/81	♀	5½	211	Solid blue	(PVC)
	3/2/81	♀	4½	311	White/red	(PVC)
	3/17/82	♀	3½	204	White/red	(PVC)
	3/17/82	♀	6½	407	Solid blue	(PVC)
Kirch	1/12/81	♀	3½-4½	310	White/red	(PVC)
	1/12/81	♀	2½	312	Red/yellow	(PVC)

Table 44. Marked bighorns on the Stillwater winter range during winter, 1980-81

Sex	Age	Eartags[1] Left	Eartags[1] Right	Collar	Band	Channel	Remarks
♀	10	-	-	Fabric	-	-	Called ewe #01; died June 1981
♀	7	02	02	XXXX White w/black	-	-	
♀	4	10	10	▲▲▲▲ White w/black	-	-	
♀	6	17	17	White	-	-	
♀	2	21	21	White w/blue	4	12	Radio quit June 1981
♀	4	24	24	Black/white	4	8	Radio quit June 1981
♀	3	25	25	White w/red	4	10	
♀	7	34	34	Red/yellow	4	4	Died June 1981
♀	13	59	-	Fabric	-	-	
♀	6	66	-	Green	-	-	
♂	5	16	16	White w/black	-	-	
♂	4	27	27	Yellow	1	10	Radio quit April 1981
♂	2	33	33	Blue	4	5	
♂	7	69	26	Red	1	5	Radio quit August 1981

[1]Yellow Ritchey eartags with black numerals.

Literature Cited

Clover, M. R. 1954. A portable trap and catch net. Calif. Fish and Game 40(4):367-373.

Cooney, R. 1936. Winter game study index, Beartooth Division, Custer National Forest. U.S.D.A. Forest Serv., Unpub. Rept.

Giest, V. 1966. Validity of horn segment counts in aging bighorn sheep. J. Wildl. Mgmt. 30(3):634-635.

_____. 1971. Mountain sheep: a study in behavior and evolution. Univ. of Chicago Press, Chicago, 383 pp.

Hamlin, K. 1982. Running away from home - a behavioral modification in adolescent mule deer designed to assuage social stresses associated with burgeoning sibling densities. Proc. of Mont. Chapt. of The Wildl. Soc., in press.

Knapp, S. 1973. Summer biology of elk on the East Boulder Plateau, Beartooth Mountains. Mont. Dept. of Fish and Game, Environ. and Inf. Div., 21 pp., mult.

Mackie, R. J. et al. 1980. Montana deer studies. Mont. Dept. of Fish, Wildl. and Parks, 205 pp.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37(1):223-249.

Overton, W. S. and D. E. Davis. 1969. Estimating the numbers of animals in wildlife populations. P. 403-455, In: R. H. Giles (Ed.) Wildlife Management Techniques, 3rd ed., printed for The Wildl. Soc. by Edwards Bros., Inc., Ann Arbor, Mich., 623 pp.

Simmons, C., S. Stewart and T. Butts. 1981. Big game survey and inventory, deer and elk, Region 5, Job Prog. Rept., Mont. Fish, Wildl. and Parks, 121 pp.

Stoneberg, R. J. 1977. Beartooth-Absaroka wildlife-mining research. Fed. Aid to Fish and Wildl. Rest. Proj. FW-2-R-5, Mont. Dept. of Fish and Game, Helena, 156 pp.

Stewart, S. T. 1975. Ecology of the West Rosebud and Stillwater bighorn sheep herds, Beartooth Mountains, Montana. Unpub. M.S. thesis, Mont. State Univ., Bozeman, 130 pp.

_____. 1980. Mortality patterns in a bighorn sheep population. Proc. of the Bien. Symp. of the No. Wild Sheep and Goat Coun., Salmon, Idaho, pp. 313-329.

Mitigation Measures Proposed as Compensation for Wildlife Habitat Degradation Associated with the Proposed Anaconda Minerals Company Mining Operation in the Upper Stillwater Drainage

Submitted to:

Montana Department of State Lands

by:

Montana Department of Fish, Wildlife and Parks

August 1982

Mitigation

The Upper Stillwater Valley, one of south central Montana's primary recreation areas, supports a wide variety of wildlife species. This area is particularly important winter range for bighorn sheep, elk, mule deer and white-tailed deer because of its diverse habitat types, light snowfall and wind patterns which keep large areas relatively snow-free throughout much of the winter. Big game populations are particularly vulnerable to disturbance and stress during winter months when energy conservation is an integral component of survival strategy. In the case of the mining operation proposed by the Anaconda Minerals Company, secondary impacts to winter range, which may occur over large areas, may be equally or more significant than primary impacts, which are generally more site-specific.

As discussed in the Upper Stillwater Big Game Technical Report prepared by the Montana Department of Fish, Wildlife and Parks (MDFWP), the proposed mining operation will affect big game populations, both directly and indirectly, and correspondingly affect the aesthetics and recreational potential of the Upper Stillwater Valley. Mitigation should be directed at 1) minimizing potential impacts as they have been identified to date, 2) monitoring affected wildlife populations for the duration of the mining operation in order to minimize future impacts as problems develop and 3) donating land or the use thereof to the State of Montana for enhancement of the wildlife resource, as compensation for the loss of wildlife and its habitats due to mining activity.

A cut-and-fill stoping mining plan was not addressed as an alternative in Anaconda's Draft EIS. The MDFWP proposes that this alternative be strongly considered as a wildlife mitigation measure. A cut-and-fill stoping mining operation with the mill site located on the mine site would confine wildlife impacts to a smaller area than the proposed plan, with the mill located on the Hertzler Ranch. This alternative mine plan would minimize destruction of mule deer habitat, road mortality of mule deer, white-tailed deer and bald eagles, and

would eliminate haul road impacts to the historical peregrine falcon nest site. This alternative would also lessen the likelihood of tailings pond water leaching into the groundwater and ultimately the Stillwater River and the possible toxic effects of settling pond chemicals (particularly Dowtroth and Aeroxanthate 350) on waterfowl, shorebirds and bald eagles. If a cut-and-fill stoping mining operation were to be implemented, it should be in conjunction with mitigating measures #1-8. If the proposed mine plan (with the mill located at the Hertzler site) were to be implemented, it should be in conjunction with mitigation measures #1-12.

Specific mitigation measures are as follows:

1) To minimize human activities on the bighorn sheep winter range, the highway that bisects it should be relocated to approximately its original route (shown on 1939 USGS topographic map) between Verdigris Creek and the Beartooth Ranch.

2) To compensate for habitat lost or rendered unsuitable in the vicinity of the mine site, a conservation easement should be applied to the Beartooth Ranch property, prohibiting further development. Agricultural uses would be allowed to continue and winter range presently owned by Anaconda Company would forever remain available for the Stillwater bighorn sheep herd and mule deer which migrate from Yellowstone National Park.

3) Anaconda Company should finance the monitoring of population dynamics, movements and habitat use of the Beartooth mule deer herd, Stillwater bighorn sheep herd, Stillwater elk herd and Stillwater black bears on an annual basis for the duration of the mine's life. Monitoring must include the use of an adequate number of radio-marked animals to provide meaningful data to adequately assess impacts. The MDFWP would be responsible for direction of the monitoring program.

4) To eliminate the possible complicating factor of stress on the inbred bighorn sheep population, Anaconda Company should finance the transplant of unrelated rams into the Stillwater population. This would improve the genetic

health of the population and make it less vulnerable to mine-related disturbance and stress. Direction of all aspects of such a transplant would be the responsibility of MDFWP.

5) If the Stillwater bighorn sheep population is severely reduced (to 20 individuals or less) during the life of the mine or within 3 years following the last mine-related activity, Anaconda Company must fully fund all transplant efforts necessary for complete reestablishment of a bighorn sheep population. Direction of such a transplant effort would be the responsibility of MDFWP.

6) It is imperative that measures be taken to protect elk wintering areas from further disruption and human activity. To establish an elk wintering area isolated from human and mine-related disturbance, it is proposed that Anaconda Company secure a conservation easement on the Picket Pin Ranch property, prohibiting further development. Agricultural uses would be allowed to continue. Closure of this area to motorized vehicles (particularly snowmobiles) during the period December through April should be pursued in cooperation with the U. S. Forest Service.

7) If a large number (eight or more) of mine workers (construction or operations) are housed in any general area in excess of 5 miles from their primary place of employment, Anaconda Company should initiate a mandatory bussing system to transport these employees to and from work.

8) Any Anaconda Company employee found guilty of a major violation (fine or bond of $300 or more) of state or federal laws involving fish and wildlife resources should have his/her employment immediately terminated.

9) To minimize deer road kill mortalities along the haul route, speed limits should be posted and enforced along its entire length. Sections of road delineated as white-tailed deer crossing areas should be identified by deer crossing signs.

10) To minimize destruction of white-tailed deer habitat, the final segment of haul road between the Nye road and the Hertzler mill site should be located away from deciduous growth associated with the West Fork of the Stillwater River.

11) Disturbance of alfalfa fields on the Hertzler Ranch should be minimized during mill construction. These fields should be maintained as alfalfa fields throughout the duration of mill operation.

12) Anaconda Company should finance the monitoring of population dynamics, movements, distribution and habitat use of the Keogh and Limestone mule deer herds, Stillwater white-tailed deer and Stillwater black bears on an annual basis for the duration of the mine and milling operation. Monitoring must include the use of an adequate number of radio-marked animals to provide meaningful data to adequately assess impacts. The MDFWP would be responsible for direction of the monitoring program.